THE PRACTICAL DICTIONARY OF MECHANICS

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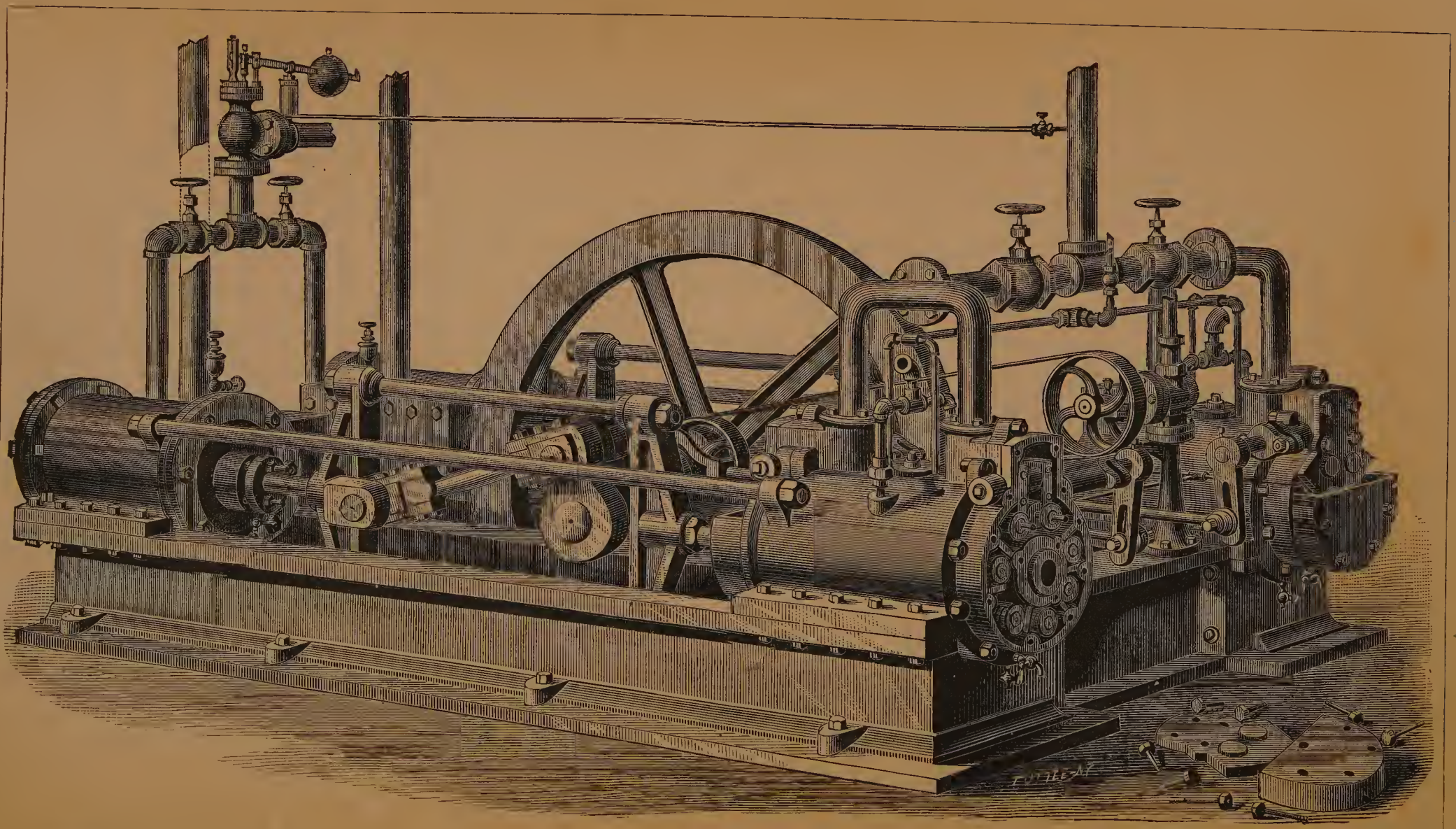

PLATE I

CLAYTON DUPLEX AIR COMPRESSOR.

See page 14.

THE

PRACTICAL

DICTIONARY OF MECHANICS:

BEING

A DESCRIPTION OF TOOLS, INSTRUMENTS, MACHINES, PROCESSES, AND ENGINEERING; HISTORY OF INVENTIONS; GENERAL TECHNOLOGICAL VOCABULARY;

AND

DIGEST OF MECHANICAL APPLIANCES IN SCIENCE AND THE ARTS.

By EDWARD H. KNIGHT,

CIVIL AND MECHANICAL ENGINEER, ETC., U.S.

Illustrated

WITH UPWARDS OF TEN THOUSAND ENGRAVINGS.

DIVISION VII.,

Being a Supplementary Volume (with Index References to Technical Journals 1876—1880).

"Thus Time brings all things, one by one, to sight,
And Skill evolves them into perfect light."

LUCRETIUS, Book V.

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PREFACE.

The march of mechanical improvement, in the five years that have elapsed since the publication of the MECHANICAL DICTIONARY, renders it necessary to issue another volume, to keep the work abreast of the time.

The two great Exhibitions, at Philadelphia and Paris—with each of which the author was officially connected as Delegate or Commissioner, and as a member of the respective juries—have brought forward a world of new matter; and the records of our own Patent Office, as well as the testimony of our technical journals, bear witness to the fact that at no period has invention been more fertile, more brilliant, or more important.

The difficulty is not in filling a book, but in selecting the more important subjects to fill given bounds; and the lavish abundance of the material has been such that it has necessitated the introduction of a new feature into the work—that of copious references to the technical journals of the period 1876–1880, inclusive—for fuller statement of the subject matters involved.

The author cherishes most confidently the belief that this feature will meet the approbation of readers and enquirers, and hopes that it may prove to the student in machinery, what William of Malmesbury said of a cognate subject—the introduction of the Arabic [Indian] numerals into Europe by Gerbert of Auvergne—"A great blessing to the sweating calculators."

EDWARD H. KNIGHT.

WASHINGTON, U.S., *June* 1, 1881.

POSTSCRIPT.

DR. KNIGHT, whose name is so honourably connected with the MECHANICAL DICTIONARY, did not live to see the final publication of this volume. He was engaged upon the final section when he was taken ill, and died January 22, 1883. It was found, after his death, that he had left the remainder of the work in such a forward state of preparation that the task of editing was confined chiefly to such arrangement of his material as would bring it into the order which Dr. Knight was following. While, therefore, the Publishers share with the patrons of the work the regret that its accomplished editor could not give the final touches to his Dictionary, they take satisfaction in knowing that the work was wholly his.

January, 1884.

LIST OF SPECIFIC INDEXES.

The Specific Indexes in the following List are to be found in their alphabetical places in the body of the work. Each Index embraces the technical appliances, etc., appertaining to its subject.

Agricultural Implements.
Air Apparatus, Blowers, Ventilation, etc.
Anchor.
Art, in various materials.
Aural Instruments.
Barrel Making Machinery.
Barrow.
Beet Root Sugar Machinery.
Bit.
Blocks and Rope-leaders.
Boat.
Boiler Fittings.
Bolt.
Bone Instruments.
Boring Tools.
Bronze.
Bullet Instruments.
Carriage and Wagon Hardware.
Cement, Plaster, Glue, etc.
Ceramics.
Clamping Tools, Vises, Wrenches, etc.
Coil.
Compositions, Water-proofing, etc.
Core.
Cotton Machinery.
Drawing, Writing, Copying Instruments and Processes.
Ear Instruments.
Electricity, Telegraphy, etc.
Embryotomy Instruments.
Explosives.
Exsection Instruments.
Eye Instruments.
Fabric.
Fine Art Metal-work.
Fire-arms, Ordnance, Explosives, etc.
Fishing and Whaling.
Forceps (Surgical).
Furnace.
Galvanic Battery.
Gas.
Glass.
Grain Cleaning and Grinding.
Grinding and Polishing Tools, etc.
Gun Hand-tools.
Gun Machines.
Hammer.
Hand Tools.
Hardware, House, Carriage, Wagon, etc.
Harelip Instruments.
Heating and Lighting.
Hinge.
Hoisting, Shafting, Gearing, Grappling, etc.
Hook.
Hydraulic Engineering.
Knife.
Knot.
Laryngeal Instruments.
Lead Alloy.
Leather.
Leather, Tanning, etc.
Lens.
Lifting Jack.
Line.
Lock.
Machine.
Measuring, Calculating, Testing, and Recording Instruments.
Meatus Instruments.
Metallurgy.
Mill.
Milling.
Music.
Nail.
Nasal Instruments.
Nautical.
Needle.
Net.
Optical Instruments, etc.
Ovariotomy Instruments.
Paper, Printing, Books.
Phonic Apparatus.
Pipes, Valves, and Plumbing.
Pipe Coupling.
Plow.
Polishing.
Porcelain Colors.
Portable Engine.
Presses.
Pumps, Water Engines, and Wheels.
Railway Apparatus, Running Stock, and Parts.
Rectal Instruments.
Saw.
Scissors.
Scrotal Instruments.
Shears, Scissors, etc.
Sight.
Skin Grafting Instruments.
Spinning, Textile Machinery, Fabrics, Sewing, Knitting, etc.
Spiral Spring.
Spring.
Steam, Gas, and Air Engines.
Stone Cutting.
Testing Machine.
Urethra Instruments.
Urinometer.
Uterine Apparatus.
Vehicles.
Vehicles and Menage.

KNIGHT'S

MECHANICAL DICTIONARY.

[An asterisk (*) indicates that an article or description referred to is illustrated.]

A.

A-ba'ting. Properly, *bating*. A steeping process in tanning. See BATING.

A-bat-toir'. A city slaughter-house, where are assembled all the conveniences for butchering the animals and putting the offal into merchantable form. The plans usually involve humane, rapid operations and relatively cleanly and wholesome surroundings. See notices of the abattoirs of

Philadelphia . . . *"*Scientific American Sup.,"* 1375.
Brighton. *Lawson* . . *"Scientific American Sup.,"* 1939.

Ab'scess Knife. A pocket instrument with a curved blade, the edge on the concave, and contained in a tortoise-shell or ivory handle.

The abscess lancet is a pointed thumb lancet in tortoise-shell scales.

Ab-sor'bent Stra'ta Wa'ter-pow'er. An invention of M. G. Hanrian, of Meaux, France, for utilizing the descent of water in a tube leading from a water-bearing to an absorbent stratum as a source of power. The water passing downward in a vertical well-tube acts upon the buckets of an endless chain, which passes over a wheel above and rotates it.

The invention is described and illustrated in the *"Bulletin du Société d'Encouragement pour l'Industrie Nationale,"* and is reproduced in *"Scientific American,"* * xxxiv. 159.

Ab-sorb'ing Well. A well or deep pit sunk into an absorbent stratum, and used to carry off drainage.

These wells are used in certain localities in the United States where a retentive stratum of clay rests upon gravel or sand, as in Alexandria, Va., where the drainage of the town is mostly obtained in this way, by well or cesspools dug into the substratum.

Ab-sorp'ti-om'e-ter. An instrument invented by Bunsen for measuring the absorptive power of gases.

A-but'ment. (*Add.*) 7. (*Carpentry.*) The shoulder on a joiner's plane between which and the plane-bit the wedge is driven.

A-but'ment Crane. A crane mounted upon an abutment or pier, of a viaduct, for instance, and ascending with the elevation of the structure.

Figure 1 represents a small crane of this nature, used at the Viaduc de l'Indre. It was fixed on the piles, and then upon the masonry, being readily raised step by step as the structure advanced. In the instance cited two horses were attached to the rope by which the material was drawn up.

Ac-cel'er-a'tor. (*Ordnance.*) A cannon with additional charge chambers, exploded consecutively in the rear of the shot, in order to give the ball the additional force due to the consumption of a large charge without the strain incident to exploding too large a quantity in a single mass. Lyman's United States patent, No. 16,568.

An experimental gun on this principle was tested in New York and elsewhere and is shown and described in *Holley's "Ordnance and Armor,"* *p. 885.

Ac-cu'mu-la'tor. 1. A device for storing power; as in the case of Sir William Armstrong's invention, in which the water from a pump is caused to raise a series of weights which press upon the column, and form a reserve of power for the working of an elevator, a punching machine, shears, or a riveter, as in the case illustrated in Fig. 2.

The central stem of the accumulator is fixed, and serves as a guide for a cylinder which slips upon it and carries the weights, which in the present case are annular iron blocks surrounding the cylinder. The water forced by the pump arrives from beneath and fills the annular space between the cylinder and the central guiding stem, so that the weight of the iron blocks and the cylinder is carried upon the column of water. The water is furnished by two pumps of 1 5″ diameter and 3.5″ stroke, driven by band and pulley, the latter making 100 to 120 revolutions per minute. When the weighted cylinder arrives at the end of its course

Fig. 1.

Abutment Crane.

it actuates a rod which closes the induction cocks of the pump, and cuts off the supply of water.

The water from the accumulator enters the working cylinder of the riveting machine by one opening and leaves by another, each being provided with valves. A hand lever admits the water to make the effective stroke, the water exit being closed either by the pressure of water or by a

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spring. The induction valve remains open until the rivet is finished, or for any length of stroke required, as the case may be, and when it is desired to arrest the motion the induction valve is closed.

To make the reverse motion, the water-exit valve is opened by a motion of the hand lever in the contrary direction from that to admit the water; the water runs out of the cylinder, and the piston is driven backward by the action of a small cylinder placed in the piston and which is put in communication with the accumulator by a special pipe and valve.

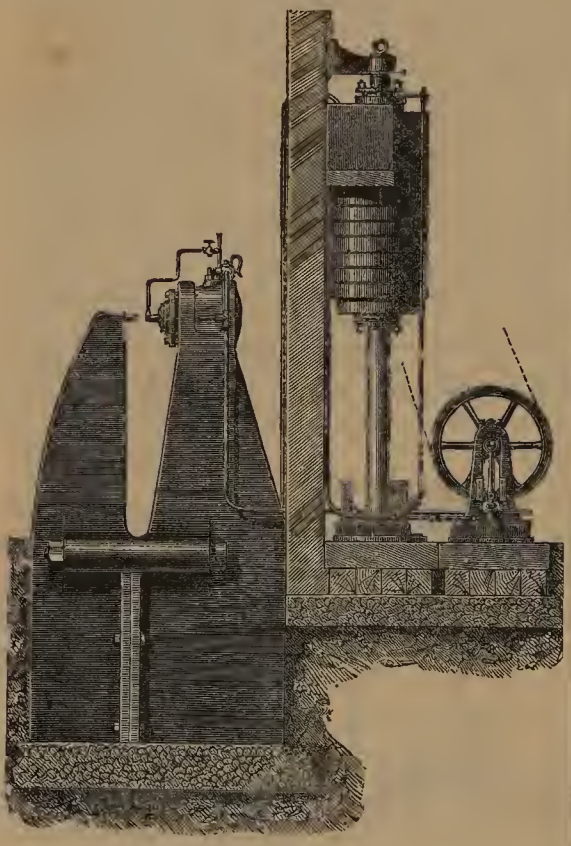
The machine is designed to place 900 to 1,000 rivets of 30 millimeters, in sheet iron of 20 millimeters, in 10 hours: and in smaller works to place 6 to 7 rivets per minute.

Machines in which the suspended swage cylinder is capable of presentation to rivet in any direction are noticed under RIVETING MACHINE, and one is shown in Fig. 4351, page 1949, "*Mech. Dict.*"

The weight-case accumulator is shown in Fig. 4, page 9, vol. i.

A hydraulic riveting machine, with two movable jaws, but without accumulator, is shown in Fig. 4354, page 1949, "*Mech. Dict.*"

Fig. 2.



Sir William Armstrong's Accumulator as applied to a Riveting Machine.

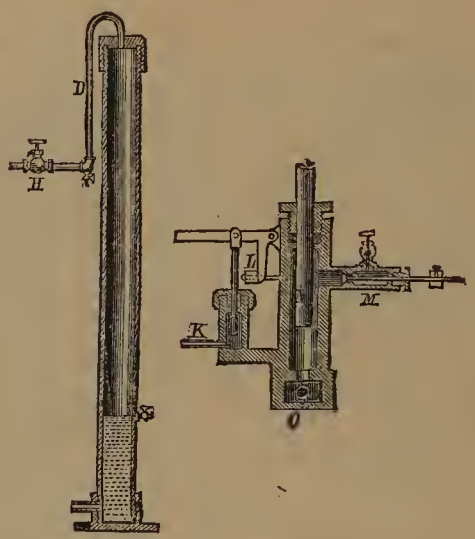
In Kinney's hydro-pneumatic accumulator, compressed air is made the reservoir of power. Like other familiar applications of the accumulator it is designed to be used in connection with the hydraulic press, but the pumps force water into and compress air in vertical cylinders. The pumps work continuously until a stated pressure is attained, when, by automatic mechanism, valves are opened which prevent any further delivery; the pumps merely working the water to and fro till a remission of pressure by the use of some of the stored force puts them in service again.

A number of these vertical cylinders are connected in series by pipes above (*D H*) and below so as to have communication, by which the pressure in them is equalized, and for use in charging them with air at the desired normal tension. See view of a battery of accumulators, page 121, vol. xxxviii., "*Sc. American.*"

The cut shows a section of one of the accumulators, and a sectional view of the apparatus for rendering the pump ineffective when the maximum stated pressure is attained.

Proceeding from the gage pipe is a tube *K*, connecting with a small chamber, in which is a plunger with a weighted lever whose arm *L*, when the lever

Fig. 3.



Kinney's Hydro-Pneumatic Accumulator.

is lifted, withdraws the valve in *M*, and opens communication between the pump cylinder *N* and the pipe *O*, leading to the tank from which water is supplied.

Hydraulic accumulators are made in variety under various applications by Tweddell of England; such, for instance, as —

Weight-case accumulators.
Differential accumulators.
Basement accumulators.

Morane, of Paris, makes them specifically for the stearine and other chemical industries.

Sellers & Co., of Philadelphia, for riveting machines, etc.

An excellent and compact arrangement is shown in figures 8, 9, 10, 11, article "Presse," Prof. Chas. Laboulaye's "*Dictionnaire des Arts et Manufactures*," edition of 1877.

The portable hydraulic accumulator used in the works at the St. Gothard tunnel consisted of a vertical cylinder, in which a piston traveled, and which had to be loaded to a weight equivalent to 450 lbs. per square inch. When the lift was not in operation, the piston was raised to an extent proportionate to the quantity of water introduced, which it returned to the lift when the ingress cock of the latter was opened. The diameter of the piston was 11.81″ diameter, and the stroke was 66.93″. The volume of water contained was 26.2 gallons, and the pressure on the piston 21.18 tons; the piston and crosshead weighed 1.18 tons. A load of 20 tons of lead ingots was suspended to the cross-head at the top of the piston. These could be removed at will to fa-

cilitate the moving of the apparatus from place to place on the works.

Views of the accumulator and the hydraulic pumps are reproduced in the "*Scientific American Supplement,*" * pages 104, 105.

2. (*Electricity.*) *a.* In dynamo-electric machines, one in which the residual magnetism of the field magnets generates in the armature coil a feeble initial current which increases the magnetism of the field of force magnets, thus producing a stronger current, and so on reciprocally to the maximum.

The first patent in which this feature is present is S. Hjorth's English patent No. 2,198, October 14, 1854. The Dane is evidently entitled to the credit of the invention of this most important feature in dynamo-electric machines.

"This principle, of which we discover the application in almost all dynamo-electric machines, is that of the gradual successive increase of power in an electro-magnetic system under the influence of the currents of induction which it develops. It is sufficient for the purpose that a trace of magnetism remains in the armature to produce the amerçage and augmentation of the strength of the armature until the maximum is reached, dependent upon the strength, the resistance of the circuit, and the saturation of the armatures." — "*La Lumière Electrique.*"

The presentation of the memoirs of Wheatstone and Siemens on this subject at the Royal Society Meeting, February 4, 1867, was more than 12 years subsequent to the patent of S. Hjorth, of Copenhagen. See DYNAMO-ELECTRIC MACHINE.

b. See SECONDARY BATTERY. *Faure.*

3. A resilient section, in a chain or rope, usually a drum of caoutchouc, used in British dredge-lines; whereby a certain amount of elasticity is given to the towing rope, preventing the parting of the rope, and giving the man on watch a chance to cast-off, to prevent losing the dredge, which has become fouled or full.

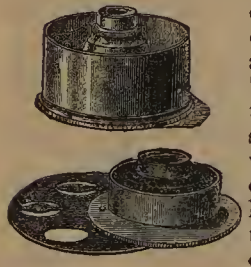
Beardslee's method is to have a certain amount of slack rope held in reserve by a check rope, which breaks when a given strain is brought upon the main rope. See CHECK-ROPE.

See the following references: —

HYDRAULIC. *Merdach.* Paris. "*Iron Age,*" xvii., January 13, p. 9.
Grimshaw. (Patent April 16, 1878.) "*Iron Age,*" * xxi., June 20, p. 7.
Tweddell. "*Railroad Gazette,*" * viii. 563.
"*Manufacturer and Builder,*" * xii. 105.
"*Engineering,*" * xxvi. 271.
Best & Marshall. "*Scientific American Supplement,*" * 3659.
"*English Mechanic,*" * xxvii. 455.
Kinney. "*Scientific American,*" * xxviii. 127.
Kingston-upon-Hull, Eng. "*Van Nostrand's Mag.,*" xviii. 211.
ELECTRIC. English Patent. No. 2198, October 14, 1854.

Ach'ro-mat'ic Con-den'ser. (*Optics.*) An attachment to the microscope, used when the light from the concave mirror proves insufficient for any object requiring an intense transmitted light. The condenser slides, by its tube, into the fitting under the stage of the instrument, in which it has to be moved up or down until the focus of its lenses falls upon the object, the light having been previously reflected in the proper direction by the mirror.

Fig. 4.



Achromatic Condenser.

The upper figure shows a simple form; the lower is Webster's form of Crouch's achromatic condenser, provided with a revolving diaphragm having various forms of apertures.

Ach'ro-mat'ic Right'-an'gle Prism. An achromatic form of the right-angle prism, which is an attachment to the microscope designed for throwing rays of light at right angles, giving more perfect reflection. See RIGHT-ANGLE PRISM.

Ac'id Pump. A pump constructed for drawing off corrosive liquids, emptying carboys, etc.

It is a portable pump, made of glass, and convertible into a siphon by the addition of an extension tube of caoutchouc to the nozzle. A large India-rubber air bulb produces the vacuum and expulsion, but does not receive any of the liquid. The valves are glass poppets, riveted, while hot, into their seats. The joints in the pump are of accurately ground glass. The nozzle is also so jointed as to be flexible.

See *Nichols'* pump. "*Scientific American,*" * xliii. 232.

Also the air-forcing pump of Wyllie, of Hebburn-on-Tyne, England, used for pumping acid to cisterns at a height of 80′. The air-pressure registers from 70 to 100 lbs.

"*Engineering,*" 1876.
"*Scientific American Supplement,*" * 524.

A'cier-age. A mode of coating a metallic plate with a surface of iron or steel; used to enable stereotype and copper plates to print a larger number of impressions. Invented by Garnier of Paris. See *Photographic Journal,* vol. vi., p. 31 *et seq.*, September 15, 1859.

A'corn-head'ed Bolt. A carriage-bolt with an ornamental head finished in silver, oroide, or gold, and in shape resembling an acorn.

A-cou'me-ter. (*Surgical.*) An instrument for measuring the degree of hearing. *Acouömeter, Acoëmeter, Acousimeter.*

The instrument affords a source of sound of constant intensity and pitch, and is a substitute for the whisper and the watch, each of which has its difficulties. The voice is a complicated sound, the intensity of which it is difficult to regulate, and consonant sounds vary greatly in their audibility at given intensity. The watch has two tones with slight intensity, both audible when close, and but one at a greater distance.

The first acoumeter was made by Schafhäntl, who made use of a ball falling from a certain height as a source of sound. Wolke invented a pendulum acoumeter. He employed an upright sounding-board of fir, against which an oaken mallet was allowed to fall through a given space. Itard had a freely suspended copper ring which was struck by a pendulous metallic ball. The elevation of the pendulum was measured on a graduated quadrant, and the intensity of the tone thereby determined.

Politzer's acoumeter gives a sound of unvarying character, and the estimate of the degree of hearing of the patient is obtained by making the clicks of the instrument more or less remote from the ear. It consists of a steel cylinder 4 millimeters in diameter and 28 millimeters long, set in vibration by the blow of a small steel hammer, and applied in the vicinity of the external ear. The cylinder is fastened to a small column of vulcanite, the hammer being freely suspended from a slot in this column by means of a pin. The tail end of the hammer shaft, projecting behind and beyond the column can be depressed to a certain point, and, when liberated, allows the hammer to strike the cylinder

from a certain height, thereby insuring a certain intensity of tone. Half rings being fastened at either end of the vulcanite column, the instrument may be held between the thumb and forefinger, the middle finger being free to set the hammer in motion.

Fig. 5.

Politzer's Acoumeter.

A small disk is fastened to the column by means of a pin, and is used for testing perception for tone conduction from the mastoid. The illustration shows this application of the instrument.

The determination of the hearing distance is usually conducted by approaching the instrument to the ear until the patient announces that he begins to hear its tone, and it is well to require him to count the number of blows.

"*Archives of Ophthalmology and Otology*," vi., 603 *et seq.*

A'cou-sim'e-ter. A synonym for acoumeter. *Itard.* See ACOUMETER.

A-cous'tic Tel'e-graph. One which transmits sonorous vibrations. The articulating telegraph known as a telephone, is at present the acme of the art. The United States patent of Lancelot H. Everitt, of New Orleans, dated March 24, 1868, and No. 75,886, is a curious item in the history of the art. See, also, his patent No. 40,616, dated November 17, 1863. The summation states that "sounds produced at one end of the telegraph are transmitted to the other end along a wire."

The first claim (of four) may be inserted (Patent of 1868):—

"*Claim.*—1. An acoustic battery for telegraphing, a machine which creates and modulates sounds, that, when arranged and sounded under symbolic formulæ, they are made to represent and express all the letters of the English alphabet and all Arabic notatious, and when thus evoked into existence the machine reflects these sounds and transmits them through naked wire, buried in the land or water, to their destination, where they impart their various interpretations with such distinctness and order to the auditor who receives them as to become the most important and efficient commissioners of intelligence."

Ac'ti-nom'e-ter. An instrument for measuring the power of the sun's rays.

Herschel's actinometer (described on page 11, "*Mech. Dict.*"), consisted in a small open receptacle, attached to a fixed standard.

Pouillet's pyrheliometer (described and illustrated on p. 1837, "*Mech. Dict.*") was of polished silver. The vessel exposed to the solar rays contained 100 grams of water, was 100 millimeters in diameter, and 15 millimeters in thickness. It was covered on the exterior with lampblack. This instrument could not, however, be used in winter when the temperature fell below 32° Fah.

To avoid the various defects of the instrument and to obtain exact measurement of the intensity of solar heat, Capt. John Ericsson invented the actinometer, or solar calorimeter. The instrument is fixed on a movable table within a rotary observatory. It consists of a copper receptacle, filled with water, and covered with lampblack on the exterior exposed to the sun. A thermometer placed in the liquid indicates variations of temperature, and an agitator, moved by a belt passing over a little pulley, keeps the water in motion and insures its equable temperature. The water-vessel is placed in the bottom of a chamber, the flaring mouth of which receives a plano-convex lens whereby the rays are concentrated upon the calorimeter. In this chamber as nearly a perfect vacuum as is possible is maintained, and a water jacket is provided so that the interior temperature may be constant.

See "*Scientific American Supplement*," * p. 1103, where is also shown a modified form of instrument, also by Ericsson, for obtaining the measure of the intensity of the solar radiation at a given moment.

An apparatus to measure and record the variations of daylight throughout the day, has been invented by Herr Kreusler, of Bonn.

The apparatus has a special bearing upon plant physiology, and consists of a drum, fixed with its axis in the plane of the meridian, and adjustable so as to be at right angles to the sun's rays. This drum has its border divided into 24 hours, — 12 noon and 12 midnight being in the meridian plane. A strip of paper, sensitized with solution of bichromate of potassium, and having divisions which correspond to those on the drum, is placed round this. A second drum closely surrounds the first, and is turned by clock-work (from which it can be detached) once in 24 hours, in the direction of the sun's apparent course. The second drum has a slit for admitting light to the paper; its width is such that any point on the paper is exposed 20 seconds as the slit passes over. The whole apparatus is placed in the open air under a glass bell jar. The paper strip is placed in its right position at night or under artificial shade (to avoid coloration), and the outer drum slid over and so attached to the rotating axis that the "insolation slit" is opposite the hour then present. The slit then begins to move round the inner drum correspondingly to the sun's course. The impressed slip, when removed in the evening, may be *fixed* by dipping in water and drying between blotting paper, and shows a mostly continuous succession of bands of various shades of brown. For comparison, Herr Kreusler made a scale of 10 degrees of darkening, exposing strips of the paper a given time under different angles of incidence of light. Bands of the experimental strip that appear homogeneous are then measured with reference to breadth and intensity, and the sum of the products of those quantities is taken as a measure of the action of light rays falling on the instrument in a given time.

Ac'tion. (*Fire-arms.*) Used generally, in reference to the position or some characteristic of the firing mechanism; as *side action, snap action,* etc.

Specifically — the iron body which lies between the barrels and the stock.

Back action when the locks are bedded into the stock alone.

Bar action when the locks are bedded partly into the stock and partly into the action. Also called *fore* action.

Ac'tu-al Cau'te-ry. The application of actual heat, as of the searing iron or galvanic wire, for searing or excision, as distinct from moxas or caustics. The latter are included under the terms *potential* or *virtual* cautery. See CAUTERY.

Ac'u-press'ure Pin. A needle for arresting surgical hemorrhage by insertion and torsion.

Fig. 114*b*, p. 38, Part I., * *Tiemann's "Armamentarium Chirurgicum."*

A'cus. A needle. The term is especially used in reference to surgical needles. A number are mentioned on p. 12, "*Mech. Dict.*" To these may be added the

Acus capitata — a pin ;
Acus invaginata ;
Acus paracentica, or *acus paracentelica ;*

synonyms for the *a. triquetra.*

See also ACUPUNCTURATOR ; DERMOPATHIC INSTRUMENTS ; HYPODERMIC SYRINGE, etc., "*Mech. Dict.*"

A-dapt'er. 1. (*Optics*). *a.* An attachment to the microscope for centering or throwing out of center the illuminating apparatus ; it is moved by rack and pinion. In the form shown it is specially contrived for Beck's "International" microscope.

Fig. 6.

Adapter.

b. In the case of object glasses made by different makers, and having different screws, a means for enabling such to be fitted to a body not specially adapted to receive them.

c. An arrangement on a stand to facilitate the use of the object-glass as a condenser.

2. In physical and chemical apparatus, a tube of varying sized ends for uniting apparatus of different sizes. Made of glass or rubber.

Add'ing Pen'cil. A small pencil-shaped adding device or arithmometer, usually having a metallic case and longitudinal slot with graduations and a traveling pointer, and a numbered disk.

Smith & Potts, * "*Sc. American Sup.*," page 542.
* "*Scientific American*," xxxv. 86. October 21, 1876.
Leuner, Ger., * ("*Deutsche Gewerbe Zeitung*," reproduced in "*Sc. Am. Supplement*," * pp. 2701–2.
Pascal's Adding Machine, "*Sc. Am. Supplement*," p. 742.

Ad'it. (*Mining.*) A level. A horizontal drift or passage from the surface into a mine.

The Joseph II. mining adit, at Schemnitz, Hungary, begun in 1782, was finished October, 1878. Its length is 16,538 meters, a little over 10¼ miles; that of the St. Gothard tunnel being 14,920, and the Mont Cenis tunnel 12,233 meters.

The object of the adit is the drainage of the important gold and silver mines at Schemnitz. It furnishes a geological section more than ten miles in length, and gives not only valuable information as to the downward prolongation of the lodes known in the upper levels, but some new ones have been traversed, and the entire series of rocks, with their mutual limits as well as modifications and occasional transitions, are disclosed without interruption.

The entire cost of the tunnel was 4,599,000 florins, — about $2,300,000. Its height is 3 meters ; width, 1.6 meter. By the methods of working employed during the last three years it would have taken but 27 years to do the entire work.

"There are 19 shafts at Pribram, which are connected at various levels. The deepest is at Adalbert, which has reached the depth of 1,020.1 meters and has thirty levels. It is the deepest perpendicular shaft in the world. At the thousand-meter level a station for magnetic observations is established. The underground workings also communicate with one another through the great drainage tunnel "Joseph II.," which is 21,906 meters long. All the water of the mines is raised to the level of this tunnel, which is 445 meters above sea-level. The total length of the galleries is 245,089 meters." — *Prof. James D. Hague*, "*Report on Mining Industries*," "*Paris Exposition Reports*," iv. 297.

The length in excess of the former statement is due to the inclusion of some branch adits.

The Rothschonberger water-adit at the Freiberg mines was completed in 1877. It conducts the water of the mines to the Elbe. The tunnel is ventilated by eight air-shafts, and lies about 400 feet below the deepest previous Freiberger water-adit. It has a uniform height of 9.84 feet, with a somewhat smaller breadth. The present length of the adit with its ramifications is 43,000 meters (all of which length is now in use), and will be when completed over 51,000 meters, or 31½ miles. The cost of the tunnel is estimated at 12,000,000 marks or $4,000,000, and will be paid for by a tax on all the mines which it directly benefits. The gradient of the floor is only 0.03m. in 100 meters.

Ad-just'a-ble-Beam' Plow. One which has a beam adjustable on a pivot upon the standard so as to throw the nose of the beam in or out of land, to adapt the implement to two or to three horses.

In one instance the beam has a pivotal connection above the standard, its rear end being adjustably attached to a heavy rod that connects the handles. The beam has what may fairly be called a *center connection*, the pivotal point being *in the middle of the work*, or center of resistance.

Ad-just'a-ble-bed' Press. A stamping, cutting or drawing press, for sheet-metal work, which can be set with level or inclined bed, to suit the requirements of special work ; notably, the making sheet-metal pans, box covers and bottoms, and similar ware.

Ad-just'a-ble Plane. A joiner's plane, so arranged that the angle of the bit relative to the bed is adjustable to suit the kind of wood being worked.

The angle of the bit varies with the work ; the harder the wood the steeper should be the pitch ; which may vary from 43° to 60° ; indeed, if the spokeshave be included, it may be said from 25° to 60°. The usual angle of the ground plane-iron is a bevel of 25° ; in the spokeshave the usual *back* of the bit becomes the *bed.*

The pitch of planes is considered under PITCH, 6, *Planes*, p. 1793, "*Mech. Dict.*"

See, also, *Holtzapffel's* "*Turning and Mechanical Manipulation*," vol. ii.

Fig. 7.

Adjustable Plane.

Ad-just'a-ble Vise. One the jaws of which may be inclined, being pivoted on the horizontal axis, so as to secure any desired presentation of the work.

Fig. 8 shows a form of vise, the jaws of which maintain their parallelism, and are concertedly adjustable in a vertical circle to give an inclined presentation, or to bring either of the respective pairs of jaws into position for work.

Ad-jus'ter. (*Surgical.*) An instrument for bringing into coaptation the parts in case of ruptured perineum.

Dr. Agnew's, Fig. 537, p. 115, Part III., *Tiemann's "Armamentarium Chirurgicum,"*

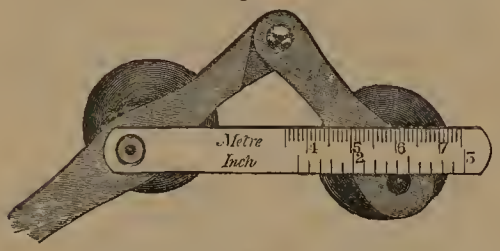
Ad-just'ing Cone. An oculist's instrument for measuring the distance between the axes of the eyes.

Fig. 8.

Adjustable Vise.

The instrument is shown in Fig. 9. Being held in the right hand, a distant object should be looked at with the right eye through the hole in the right hand cone; the other cone, fixed to an adjusting

Fig. 9.



Adjusting Cone.

arm, should then be moved backwards and forwards until the left eye sees the same object through the aperture in the left cone, and the two holes appear as one. The distance between the eyes is then indicated on the cross bar, one side of which is divided to inches and tenths, the other to millimeters.

Adze. A wood-cutting tool used with a sweeping blow, and with a blade at right angles to the length of the handle.

Some memoranda of history and principles are given on pp. 16, 17, "*Mech. Dict.*" Fig. 10 shows strictly modern varieties of American patterns.

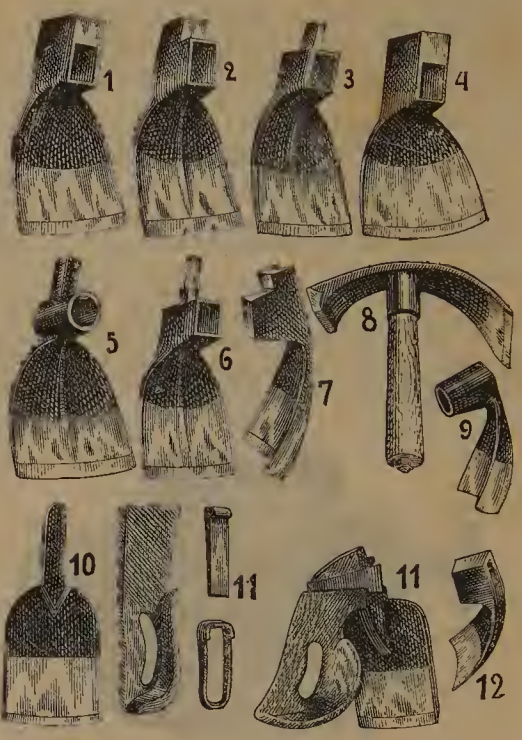
Adze-plane. A rabbeting and molding tool, especially adapted to solid paneling and used by coach and pattern makers. It has gage adjustments for depth and width of cut and for sweep in circular or crooked work.

Fig. 11.

Adze-plane.

The plane-iron is adjustable for pitch by set screw and lever, and the bed relatively thereto by thumb-screw on the side of the handle.

Fig. 10.



Adzes.

1. Flat head pattern.
2. Square head pattern.
3. Spur head pattern.
4. Railroad pattern.
5. Round eye pattern.
6. Ship carpenter's pattern.
7. Canoe pattern.
8. Cooper's pattern.
9. Special pattern.
10. Stirrup pattern.
11. Special pattern.
12. Special pattern.

The small slotted arms attached to the sides of the adjustable fulcrum are gages for depth, and a slotted piece on the bottom regulates horizontal distance from a guiding edge.

The cut shows an adze-plane and specimen of work.

The tool is perhaps well named as partaking of the characteristics of the adze and plane; but it is also nearly related to the spokeshave, though handled in a different manner.

A'er-a-ted Bat'ter-y. (*Electricity.*) One in which the exciting liquid is constantly agitated by air injected into the bath in order to depolarize the negative element.

Byrne, * "*Scientific American Sup.*," Fig. 36, page 2526.
* "*Telegr. Jour.*," vi. 222, 269, particularly used in galvano-cautery.

Air as a depolarizer in a single fluid cell is found in *Pulvermacher's* battery, "*Teleg. Jour.*," vi. 388.

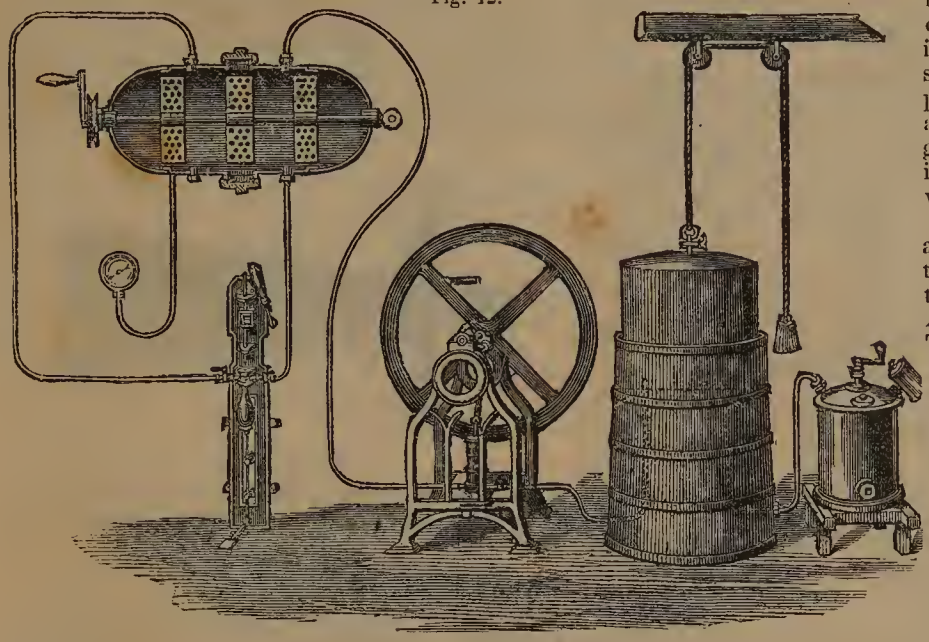
A'er-a-ted Wa'ter Ma-chin'er-y. Variously known as "Soda-water apparatus," or "Machinery for making carbonated waters," the latter being the preferable title.

The subject has been considered under the former title on pp. 18–20 and 2236, 2237, "*Mech. Dict.*" Some improvements will be noticed under CARBONATED WATER MACHINERY (which see), and certain specific heads.

Hayward, Tyler & Co.'s (British) aërated water machinery, shown at the Paris Exposition, 1878, is described in "*Engineering*," * xxvi. 287, 288, and 349–352.

The principle of an apparatus intended for making sparkling liquids, such as sparkling wines, cider, ginger-ale, etc., is readily seen in Fig. 12, which is a hand-worked apparatus capable of producing

Fig. 12.



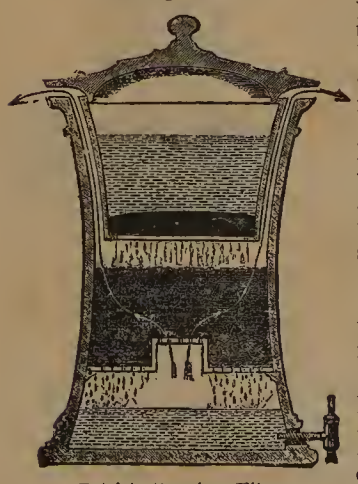
Non-continuous Aërating Machine.

sixty dozen quart bottles per day It is on the non-continuous principle, the agitator chamber on the left being charged from time to time with the liquid. This is charged by means of the gas-pump, which receives the carbonic acid from the gas-holder, and that in turn from the generator on the extreme right.

The wine or other liquor to be charged with carbonic acid gas is poured through the gun-metal cap on top, into the cylinder, which should be filled about three-fourths full; the gas is then drawn from the gasometer by the gas pump, and forced into the cylinder containing the wine; when the indicator shows the requisite pressure, the working of the pump is stopped, and the agitator in the cylinder turned a few times, which will cause the wine or other liquor to take up the gas; a further quantity of gas is then supplied by means of the pump, and the gas must be renewed as the liquor is drawn off into the bottles.

The bottling apparatus, shown beneath the cylinder, has two cocks fitted into the cone or carriage, through which the cork is driven; one is for supplying the liquor from the bottom of the cylinder, the other takes the surplus gas and foam or froth; it is connected by a pipe to the top of the cylinder, and by this means none of the liquor or gas is wasted.

Fig. 13.



British Aërating Filter

A'er-a-ting Fil'ter. One in which a current of air is conducted through the descending water.

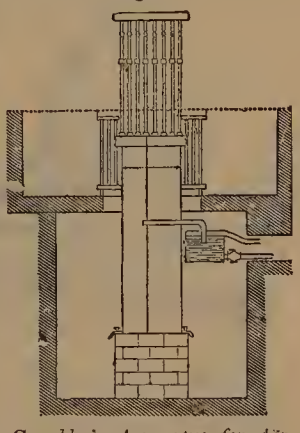
That made by the Sanitary Engineering Co., of London, is of earthenware (Fig. 13). The upper chamber has a movable pan with a block of mineral carbon. The lower has granulated carbon. The water chamber beneath being closed, the descent of water displaces the air, which ascends through the granulated material in contact with the water.

A'er-a'tor. The apparatus for aërating the water for the fish-tanks at the Aquarium of the Trocadéro, shown in Paris, is the invention of M. Gauckler, who was also the author of the original plan of the aquarium. See AQUARIUM.

The water is that of the Vanne aqueduct, and as it is obtained very near the source of the river it is deficient in oxygen, which is essential to the life of the fish, and is supplied by the apparatus shown in Fig. 14. It is placed in the center of the system of tanks in the aquarium, and consists of an application of the principle of the Catalan trumpet (*trompe*) used to operate the bellows in the iron smelting furnaces of Spain, Elba, and elsewhere. It has a number of glass tubes into which water is forced by hydraulic pressure, carrying with it bubbles of air.

Apparatus for aërating distilled water on board ship, belongs under DISTILLING APPARATUS.

Fig. 14.



Gauckler's Apparatus for Aërating the Water of the Trocadéro Aquarium. (Vertical Section.)

A-e'ri-al Light Ap'pa-ra'tus. A balloon, kite, or parachute light, used, in a military sense, for discovering the position, etc., of an enemy's camp at night. As used in recent experiments at Chatham, Britain, it consists of a kite covered with loose canvas, having a parachute provided with an arrangement for exploding the fire-balls which are sent up the line holding the kite. The fire-balls being thus discharged, illuminate the surrounding country for a considerable distance.

A-e'ri-al Pho'to-graph'ic Ap'pa-ra'tus. An apparatus for taking negatives from elevated positions. The camera is supported by a balloon steadied by guys, and the slides operated by cords from the ground. It is especially designed for mapping out an enemy's position, reconnoitering, etc. — "*Photographic News.*"

A-e'ri-al Te-leg'ra-phy. (*Electricity.*) A method of telegraphing between points, dispensing with wires, and using the aërial currents. The current is reached by flying kites to a certain height at each point, the strings being copper wires connected to instruments at the ground ends of the wire. Professor Loomis states that messages have

been thus sent by him between points twelve miles apart, using the atmospheric currents only in the interval between the kites.

A′e-ro-hy′dric Blow′pipe. A blow-pipe for burning a mixture of hydrogen and air, giving an intense heat, and used for various metallurgic works, such, for instance, as soldering platinum with gold, the brazing of copper, and the autogenous soldering of lead, without the use of an alloy of tin. The latter use is especially called for in the production of leaden vessels to be used in the making of sulphuric acid. One form of the apparatus is shown in Fig. 738, p. 309, "*Mech. Dict.*" The compound blow-pipe is the invention of Dr. Hare, of Philadelphia; he used the combination of oxygen and hydrogen. The aëro-hydric was invented by the Count de Richmont, of France. It is elaborately shown in Figs. 395–398, article "CHALUMEAU," *Laboulaye's "Dictionnaire des Arts et Sciences,"* vol. i., edition of 1877.

A′er-o-phone. 1. An invention of Edison for amplifying sound.

Its object is to increase the loudness of spoken words without impairing the distinctness of the articulation. The working of the instrument is as follows: —

The magnified sound proceeds from a large diaphragm, which is vibrated by steam or compressed air. The source of power is controlled by the motion of a second diaphragm vibrating under the influence of the sound to be magnified.

There are three distinct parts to the instrument:

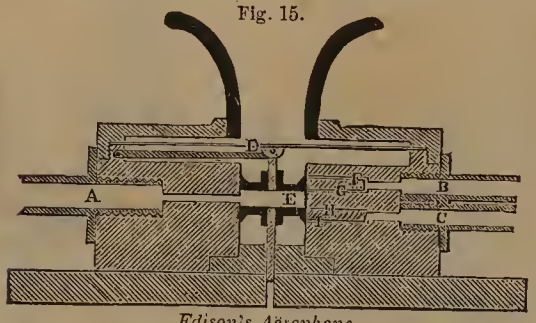
A source of power.

An instrument to control the power.

A diaphragm vibrating under the influence of the power.

The first of these is usually compressed air, supplied under constant pressure from a tank.

Fig. 15.



Edison's Aërophone.

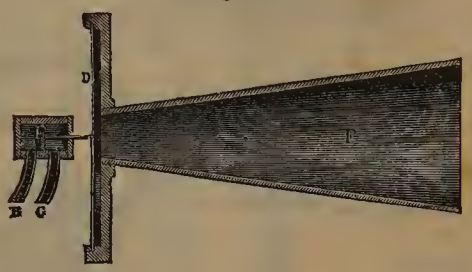
The instrument is shown in section in Fig. 15, and consists of a diaphragm and mouth-piece similar to those of a telephone. A hollow cylinder is attached by a rod to the center of the diaphragm. The cylinder and its chamber, *E*, will therefore vibrate with the diaphragm. A downward movement lets the chamber communicate with the outlet *H*, an upward movement with the outlet *G*. The compressed air enters at *A* and fills the chamber, which in its normal position has no outlet. Every downward vibration of the diaphragm will thus condense the air in the pipe *C*, at the same time allowing the air in *B* to escape *viâ F*. An upward movement condenses the air in *B*, but opens *I*.

The diaphragm *D* is shown in section in Fig. 16. Its center is attached by a rod to a piston, *P*, moving in a cylinder. The pipes *C* and *B* are continuations of those designated by the same letters in the preceding figure.

The pipe *C* communicates with one chamber of the cylinder, and *B* with the other. The piston, moving under the influence of the compressed air, moves also the diaphragm, its vibrations being in number and duration identical with those of the diaphragm in the mouth-piece.

The loudness of the sound emitted through the directing tube *F* is dependent on the size of the diaphragm and the power which moves it. The former

Fig. 16.



Aërophone.

of them is made very large, and the latter can be increased to many hundred pounds pressure. — *G. B. Prescott.*

"*Engineer*," * xlvi., 425, Figs. 32, 33.

2. An invention of Edison's, better known as a *megaphone*. It consists of a horn for talking, and a pair of horns communicating by elastic tubes with the ear, for listening. See MEGAPHONE.

An apparatus by Prof. Mayer for ascertaining the direction of sound is known as a *topophone*, and may be referred to in this connection. See TOPOPHONE.

A′er-o-phore. A respiratory apparatus containing a reservoir of vital air or revivifying composition.

Fig 17.

Schultz's Aërophore.

The aërophore devised by Herr Schultz, captain of the fire brigade at Aschaffenburg, Bavaria, depends upon the regeneration of the exhaled air, the oxygen being reproduced as it is consumed. It consists of a simple reservoir of sheet-iron, into which the products of respiration are returned. The respired air is led from the mouth by a flexible pipe to a cylindrical tube containing a layer of wadding to intercept dust, and pieces of pumice-stone saturated with caustic potash absorb the carbonic acid. This tube is in direct communication with the reservoir, as is also another tube on the other side containing pumice-stone saturated with dilute acetic acid and sprinkled with crystals of permanganate of potassium. This latter is for replacing the oxygen absorbed in respiration, and for adding a certain amount of humidity to the air, which makes it fresher for breathing. Fig. 17 shows a German fireman provided with the apparatus. The flexible tubes for inhalation and exhalation are connected with the bottom of the reservoir. The apparatus only weighs about 10 lbs., and may be used for half an hour together.

The *Galibert* and the *Rouquayrol & Denayrouze* respirators are shown on p. 1923, * "*Mech. Dict.*"

See, also, "*Scientific American*," * xxxviii 99.

A'er-o-steam En'gine. See theory of the engine by Henderson, quoted by Thurston, "*Vienna Expos. Rep'ts.*," ii. 151–160.

"*Engineer*" contains a description and illustration of *Wenham's* "heated air engine," the details being taken from a paper read by C. W. Cooke before the "Institute of Mechanical Engineers," in London. It belongs to that class in which the fire is inclosed, and fed by air pumped in beneath the grate to maintain the combustion, the whole, together with the gaseous products of combustion, being made to act upon the piston.

In addition to the British and United States patents cited on pp. 20–23, "*Mech. Dict.*," the following British patents may be noted: —

Clark, 1,449 of 1863. Air is driven into the furnace, is heated, rises with the products of combustion, meets a fine spray of water, which is instantly converted into superheated steam, and the whole passes to the cylinder.

Miller, 932 of 1864. Steam and air combined.

Boulton, 1,291 of 1864. Steam and air combined; mingles gas also.

De Rosen, 5,398 of 1826. Volatile products of combustion mingled with steam.

Vrooman, 3,083 of 1861. Charges air with moisture, and then heats it in spiral passages.

James, 1,445 of 1864. High-pressure steam and compressed air. The air is compressed by the piston in the lower part of the cylinder, and the steam then admitted to it.

Stevens, 1864. Vapor of oil is added to air, steam, and volatile products of combustion.

Cruickshanks, Eng. Pat., No. 8,141, of 1839. Expands air (previously condensed) by heat obtained from liquid fuel injected upon red-hot clay balls.

Hall, 4,935 of 1824, decomposes steam by passing it through red hot fuel, whence the gases, together with those resulting from the fuel, pass to the working cylinder.

A'er-o-ther'a-py Ap'pa-ra'tus. An apparatus in which a patient is inclosed in a chamber of compressed air as a therapeutic.

It is the opposite of the *depurator*, described on page 687, "*Mech. Dict.*," in which the expulsion of morbid matter from the excretory ducts of the skin is expedited by withdrawing the pressure of the atmosphere from the surface.

The aërotherapy apparatus is the invention of Dr. Carlo Forlanini, of Milan, Italy. It is claimed that by increasing the pressure, the air is forced into the minutest passages of the lungs, and a much greater oxygenation of the blood is secured. This is realized by those who descend into the deep caissons used in laying subaqueous foundations. Fire and lamps also burn with great energy under these circumstances.

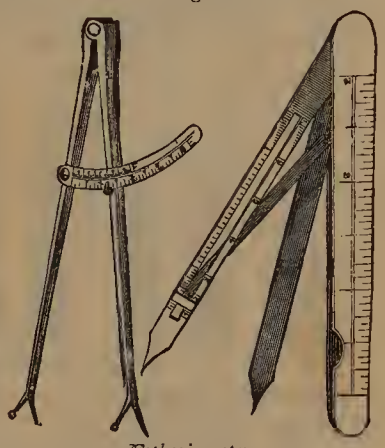
A view of the Forlanini apparatus is reproduced in the "*Scientific American*," * xxxv. 63.

See, also, *Ware's* compressed-air bath shown at Fig. 67, page 31, "*Mech. Dict.*"

Æs'the-si-om'e-ter. (*Surgical.*) An instrument for the determination of the cutaneous sensibility. Invented by Dr. Sieveking, of London, 1858. In the original form it was simply a modification of the common beam-compass. See Fig. 279, page 87, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

The "*Medical Record*," 1872, gives a drawing and description of an instrument by Dr. Alfred L. Carroll, constructed on the general plan of the two-legged compass, but with each free extremity divided into two points, one blunt and the other sharp. (Left-hand instrument in Fig. 18.) This arrangement enables the observer to determine the comparative sensibility to contact and pain at different distances by simply substituting the one pair of points for the other. Dr. Clymer provides himself with two pieces of cork or two small shot, and accomplishes the same result by placing them upon the sharp points of the ordinary instrument when he desires to test the sense of contact without danger of exciting that of pain.

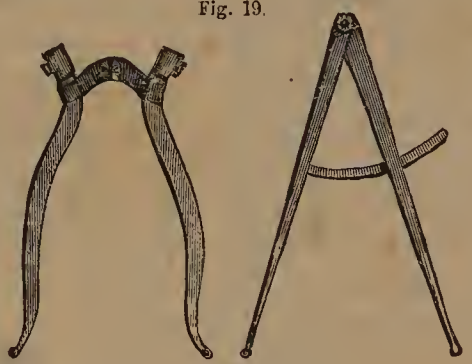
Fig. 18.



Æsthesiometer.

The right hand instrument, by Dr. Vance, exhibits a completely portable instrument. When closed, the points are in coaptation, and are received in the case the same as the blades of a knife shut into its handle. When opened and the points separated, the distance between the points is denoted by the position of the slide, which is so arranged as to move over a scale engraved on one arm of the æsthesiometer. The scale is divided into inches and twelfths of an inch. The points can be separated to the extent of 6″. When closed, the instrument is 4½″ in length.

Fig. 19.



Dr. Elberg's Æsthesiometer.

Fig. 19 shows Dr. Elberg's Æsthesiometer with electrode points.

See description of the principles and application of the instrument, under ESTHESIOMETER, p. 809, "*Mech. Dict.*" Also, article by Dr. Reuben A. Vance in "*Canada Lancet*," iv., Feb. 1872; and "*Medical World*" of the same year.

Af'ter Wale. (*Saddlery.*) The body of a collar; the portion against which the hames bear, and which rests upon the shoulders of the horse. The forward part of the collar is the *roll*.

Aft'gate. The tail-gate of a sluice or lock.

Ag'ate. A burnisher. So called because frequently made of that hard material. Blood-stones and dog's teeth are also used for burnishers.

Ag'ate Bur'nish-er. A burnisher specially used in dental operations and bookbinding; in the former for surface-finishing cement or oxychloride fillings; in the latter for smoothing the surface of gold leaf on book edges and covers.

Fig. 20 shows some forms of dentists' burnishers.

A-ga've. Nets of agave fiber were shown in the Agricultural Hall, Centennial Exhibition, from the Argentine Republic.

"The *pita* (Mexican *Ixtle*) is a variety of the agave, very prolific and yielding fibres varying in quality from the coarsest hemp to the finest flax. It is used for the manufacture of thread, cordage, hammocks, paper." — *Squier's "States of Central America,"* New York, 1858. See, also, his "*Notes on Central America,*" 1855.

Fig. 20.

Dentists' Agate Burnishers.

Age'ing. Imparting the characteristics of flavor of ripeness or age, as of clay, wine, whiskey, calico, etc. See p. 23, "*Mech. Dict.*"

Sweet's apparatus for ageing distilled spirits is shown in "*Scientific American Supplement,*" * p. 181.

Ag-glom'er-a'ted Bat'te-ry. (*Electricity.*) One in which the deploarizing salt is united by a cement and pressure so as to form a solid block with and around the negative, the porous cup being dispensed with. The improved Leclanché is an instance.

Niaudet (American Translation), * 189.
"*Telegraphic Journal*" . . . * vii. 3.

Beaufils' sulphate of mercury battery has a solid depolarizer. "*Telegraphic Journal,*" * vi. 397.

Ag'gry. Glass beads found in Ashantee and Fantee countries, and very highly valued.

They are supposed to be of ancient Egyptian manufacture. They are of many colors and patterns, the shades well marked or delicately blended, many of them resembling agates, for which they have been mistaken. The *glain neidyr*, or holy snake-beads of the Druids, found in Wales, may have had a similar origin, as the Phœnicians traded to both places, and carried Egyptian products. There are abundant evidences in the museums to prove the capability of the ancient Egyptian glass-workers to produce these objects of art. See list of Egyptian glass in Museum of "New York Historical Society," on p. 973, "*Mech. Dict.*"

Ag'i-ta'tor. 1. A stirring device used in the petroleum refining process for mixing the oil with the refining and deodorizing materials. It was formerly a series of revolving scoops, but the work is now done by blowing in air which bubbles up through the oil.

A pump used for this purpose is shown in "*Manufacturer and Builder,*" * x. 128.

The oil is treated with one and one half per cent. of sulphuric acid, by which it is bleached. It is then washed with a solution of caustic soda, followed by a little ammonia, by which the acid is neutralized.

2. A device in the carbonated water apparatus to stir the gas and water together and cause the absorption of the former by the latter. See CARBONATED WATER APPARATUS; see also cuts on p. 2236, "*Mech. Dict.*"

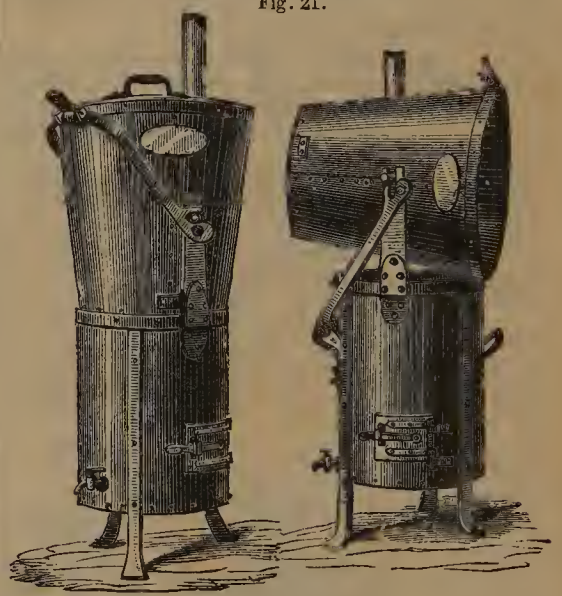
A-graffe'. (Fr. *Agrafe.*) A clasp. A hook, eyelet, or wire, by which a piano wire is firmly held, so as to prevent the translation of vertical vibration to the portion of the string between the bridge and the pin.

Decker's agraffe is a stud secured directly to the wrest-plank.

Ag'ri-cul'tu-ral Boil'er. A boiler or caldron for cooking food for animals.

The cooking apparatus made by Fouché, of Paris, is shown in Fig. 21. It is made in copper or iron, and is adapted to burn all species of fuel. One

Fig. 21.

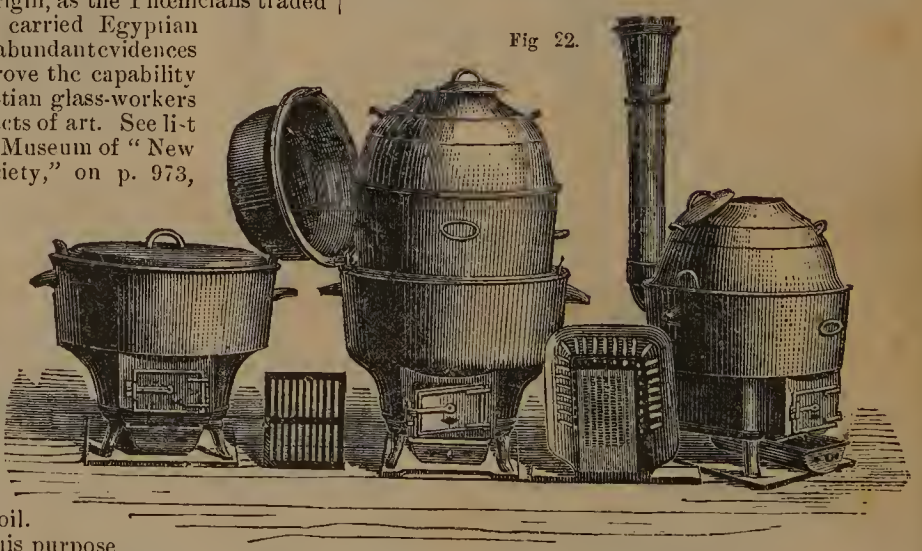


Fouche's Agricultural Boilers.

figure shows it closed for cooking, and the other in position for discharging its contents.

The caldron is suspended on posts rising from

Fig. 22.



Bodin's Agricultural Boiler.

the sides of the furnace. When at work, the bottom of the caldron fits within the top of the furnace, cleats on the vessel resting on the rim of the lower section.

When the caldron is to be discharged, it has first

to be lifted clear of the furnace so that it may swing clear. This is done by means of the bail, cams on which raise the axis of suspension of the kettle, and it may then be tipped, as shown in the figure.

Bodin's agricultural boiler is made in several forms, and is of cast-iron.

It is provided with grates for wood or for coal, and has additional steaming chambers, which may be fitted on when required to increase the capacity, the contents of each being kept distinct.

It is easily transported in sections, economical of fuel, and ready for immediate use in any place without setting in masonry.

The agricultural boiler of *Tritschler*, of Limoges, France, is portable, and has a circulation of water from the water-bath to the interior caldron, and

Fig. 23.

Tritschler's Circulating Boiler.

vice versa. The water flows over the edge into the inner vessel, and out again at holes in the bottom. The flame courses twice around the caldron, following a helical flue.

Beard's hog scalding kettle and food-boiler is an oblong sheet metal tub with a fire under one end, like some species of evaporators.

Banks' farmers' boiler is circular, of sheet-metal, hung on trunnions in a furnace, the front part of which is hinged, and is moved aside when the caldron is to be tipped to discharge the contents.

The last two mentioned are made in Chicago.

Ag'ri-cul'tu-ral En'gine. A steam-engine for farm work. Used especially in this country for threshing, but having a very much wider use in Britain and France. It is specially constructed when designed for traction, and for plowing. See Portable Engine Steam Plow.

Ag'ri-cul'tu-ral Im'ple-ments. See under the following heads: —

Agricultural boiler.
Aplatisseur.
Apple grinder.
Artificial mother.
Asparagus buncher.
Aspirator winnowing machine.
Baling press.
Balk.
Barb wire.
Barley fork.
Bean mill.
Bee-house.
Beetle destroyer.
Beet-root seeder.
Binder.
Binding reaper.
Bisoc.
Blade.
Black land plow
Board fence.
Bramble scythe.
Breaker.
Broad cast seeder.
Brooder.
Broom-corn scraper.
Broom-corn sizer.
Broom sewing-machine.
Broom trimmer.
Broom vise.
Broom winder
Brush plow.
Bush hook.
Butter box.
Butter case.
Butter print.
Butter tub.
Butter workor
Cake breaker.
Cake grinder.
Calf pail.
Cane knife.
Cart roller.
Chaff cutter.
Chaff sifter.
Chain harrow.
Cheese press.
Chicken coop.
Chicken feeder.
Chopping mill.
Churn.
Cider mill.
Cider press.
Clevis.
Clod clearer.
Clod crusher.
Clover huller.
Clover-seed gatherer.
Cockle separator.
Colter.
Combination plow.
Compound cotton press.
Concasseur.
Coop.
Corn cleaner.
Corn cracker.
Corn cutter.
Corn drill.
Corn hook.
Corn husker.
Corn mill.
Corn planter.
Corn plow.
Corn sheller.
Corn-stalk cutter.
Cotton cultivator
Cotton cylinder.
Cotton gin.
Cotton-picking machine.
Cotton planter.
Cotton plow.
Cotton press.
Cotton scraper.
Cotton-seed huller.
Cotton sweep.
Cotton-tie fastener.
Cotton truck.
Cotton-worm destroyer.
Cranberry picker
Creamery.
Crutch.
Cultivator.
Cutter.
Dairy implements
Decorticator.
Disk harrow.
Ditch cleaner.
Ditching machine.
Divider.
Double harpoon fork.
Double-mold-board plow.
Double plow.
Double shovel plow.
Double-tub press.
Drag.
Drag chain.
Drain cleaner.
Drain-tile layer.
Drill.
Dropper.
Drying house.
Duck's foot cultivator.
Duster.
Ear lifter.
Ensilage.
Ensilage cutter.
Epinette.
Equalizer
Espalier.
Evaporator.
Excavator.
Expanding cultivator.
Fanning mill.
Farm cart.
Farmer's tool-box.
Farm mill.
Feed boiler.
Feed crusher.
Feed cutter.
Feed mill.
Fencing machine.
Fertilizer distributor.
Fertilizer mill.
Fertilizer sower.
Field roller.
Flower-stand.
Fodder cutter.
Fodder mill.
Forage cutter.
Forage press.
Forking spade.
Fountain pump.
Frost cog.
Fruit basket.
Fruit-box.
Fruit dryer.
Fruit evaporator.
Fruit pitter.
Fruit press.
Fruit separator.
Gage wheel.
Gang cultivator.
Gang plow.
Garden engine.
Garden loop.
Garden tools.
Gate.
Geddes harrow
Germination apparatus.
Gorse cutter.
Grafting tool.
Grain cleaner.
Grain crusher
Grain cutter
Grain drill.
Grain fan.
Grain measurer
Grain screen.
Grain separator.
Grain ventilator.
Grape crusher
Grape mill.
Grape press.
Grapple hay-fork.
Grist mill.
Groomer.
Grub hoe.
Grub hook.
Half-shovel plow.
Hand corn-planter
Hand cultivator.
Hand rake.
Hand sceder.
Hand thresher.
Harpoon hay-fork
Harrow.
Harrow cultivator.
Harvester.
Harvester cutter.
Harvester knife.
Hay-band machine
Hay-band twister.
Hay carrier.
Hay elevator.
Hay fork.
Hay knife.
Hay loader.
Hay maker.
Hay press.
Hay rake.
Hay tedder.
Hay unloader.
Hemp knife.
Hennery.
Hill-side plow.
Hitching post.
Hoe.
Hoeing machine.
Hog scalder.
Hog trough.
Honey extractor.
Hoof cushion.
Hop picker.
Horner.
Horse biscuit
Horse boot.
Horse collar
Horse groomer.
Horse hay-fork.
Horse hoe.
Horse power.
Horse rake.
Horse rough.
Horse shoe.
Horse-shoe stud.
Hoverer.
Hurdle.
Husking glove.
Hydromère.
Incubator.
Insect destroyer
Intermediate motion.
Irrigator.
Jointer.

Knife-head.
Land roller.
Lap ring.
Lawn mower
Lawn sprinkler.
Lifting gate.
Listing plow.
Litter cutter.
Loose box
Maize cutter.
Manger.
Manure drag
Marc.
Meat chopper.
Milk cooler.
Milking tube.
Milk pan.
Milk skimmer.
Mole trap.
Movable fence.
Mowing machine.
Oat crusher
Oat separator.
Oil-cake breaker.
Oil-cake grinder.
Oil-cake mill
Olive press.
One-horse plow.
Overshot separator.
Peat spade.
Picket fence.
Picket pin.
Pig trough.
Pitter.
Planter
Plant sprinkler.
Plow
Plow fender.
Plow holder.
Pony plow
Portable cider-press.
Porter.
Post auger
Post-hole spoon
Potato assorter
Potato-bug destroyer.
Potato coverer.
Potato digger.
Potato hook.
Potato planter.
Poultry coop.
Poultry feeder
Prairie breaker.
Prairie renovator
Pruner.
Pruning saw.
Pruning shears.
Pulverizer.
Rail fence.
Rake.
Reaper.
Reaping machine.
Rice drill.
Rice huller.
Rice machinery
Rice thresher.
Riddle.
Ridging plow.
Riding cultivator.
Ripple.
Road grader
Road plow.
Roller.
Rolling colter.
Rolling colter plow
Root cutter.
Root grinder.
Root puller.
Root pulper.
Root shredder.
Root slicer.
Root washer.
Rotary plow.
Round.
Row-marker.
Runner.
Scarificator.
Scraper.
Screw press.
Scuffle hoe.
Seed drill.
Seeder.
Seeding barrow.
Seeding machine.
Separator.
Share
Share harrow.
Sheaf band.
Sheaf binder.
Sheep-rack.
Sheep-shearing machine.
Shoe pad.
Shovel plow.
Sifter
Single shovel plow.
Skeleton roller.
Skim-colter plow.
Skim-plow.
Sled harrow.
Slip share.
Soil pulverizer
Spraying machine.
Spring hoe.
Sprinkler.
Stable.
Stable cleaner
Stable fittings.
Stacker
Stalk cutter.
Stall.
Steam plow.
Steam plowing engine.
Steam reaper.
Stone clearer.
Straw cutter.
Straw elevator.
Straw knife.
Stream fence.
String binder.
Stump extractor.
Subsoiler.
Subsoil plow.
Sugar-land plow.
Sugar spile.
Sulky cultivator
Sulky plow.
Sulky rake.
Sweep.
Sweep rake.
Sweet-potato digger.
Swivel plow.
Tea-preparing machine.
Tedder.
Thatch-making machine.
Three-horse cultivator.
Threshing engine.
Threshing machine.
Tie.
Tobacco cultivator.
Tobacco cutter.
Tobacco granulating machine.
Tobacco hook.
Tobacco spinning machine.
Tobacco stripper.
Toggle press.
Tongueless cultivator.
Transplanter.
Treble tree.
Trenching plow.
Triple gang plow.
Triple plow.
Triple shovel plow.
Trough.
Turning-mold-board plow.
Turnip cutter.
Turnip drill.
Turnip fingerer.
Vine puller.
Vineyard implements.
Vineyard plow.
Walking cultivator
Walk scraper.
Weed scythe.
Wheat riddle.
Wheat separator.
Wheel hoe.
Wine filter.
Wine press.
Winnower.
Winnowing machine.
Wire fence.
Wire trellis.

Ag'ri-cul'tu-ral Lo'co-mo'tive. A self-moving steam-engine especially adapted for traction purposes on farms and plantations. But little used as yet in America, but much used in parts of Europe.

See the following: —

Ruston & Proctor, Br.	"*Engineering*"	* xxiii. 57.
Wallis & Steevens, Br.	"*Engineering*"	* xxiv 142.
Aveling & Porter, Br.	"*Engineering*"	* xxvi. 26.
Brown & May, Br.	"*Engineering*"	* x 452, 467
Howard, Br.	"*Engineering*"	* xxv. 48

Aig'let. The metallic sheath at the end of a lace or cord.

Ai'no Cloth. (*Fabric.*) A cloth made by the Ainos (tribes of the Saghalien, Yesso, and Kurile islands), from the divided fibers of the elm, beaten so as to obtain bast layers, which are split and woven. See Prof. Penhallow * in "*American Naturalist*," also "*Scientific American Supplement*," 3883.

Air (or *foul air*). A molder's term, signifying all the gases generated and driven through the sand and from the mold by the hot metal.

Air-ap'pa-ra'tus, Blow'ers, Ven'ti-la'tion, etc. See under the following heads: —

Aërated water machine.
Aërating filter
Aërator.
Aërophore.
Agitator.
Air bag.
Air brake.
Air chamber.
Air compressor
Air engine.
Air equalizer.
Air filter.
Air governor.
Air injector.
Air moistener.
Air-pressure regulator.
Air pump.
Air reservoir.
Air ship.
Air telegraph.
Air trap.
Air valve.
Aspirating filter
Aspirator.
Balloon.
Bench forge.
Bellows.
Blast regulator.
Blower
Blowing engine.
Blowing machine
Blow-pipe.
Brazing blow-pipe
Carbonated-beverage app's
Compressed-air engine.
Compressed-air governor.
Compressed-air pump.
Damper.
Damper regulator.
Double-blast forge.
Exhauster.
Exhaust fan.
Fan.
Fan blower.
Fan forge.
Fan jet.
Fanning mill.
Fog trumpet.
Forge.
Gas blow-pipe.
Greenhouse ventilator.
Guibal fan.
Hand blower.
Hot-air syringe.
Hot-blast blow-pipe
Hydraulic blower.
Hydro-pneum. accumulator
Kite.
Laboratory forge
Miner's forge.
Mine ventilator.
Organ blower.
Parachute.
Pneumatic conductor.
Pneumatic dispatch.
Pneumatic elevator
Pneumatic grain elevator.
Pneumatic hoist.
Pneumatic pump.
Pneumatic railway.
Pneumatic screw.
Pneumatic signal.
Pneumatic telegraph
Pneumatic tube.
Pneumatic tubular dispatch
Portable forge.
Pressure blower.
Pressure regulating valve.
Pressure regulator.
Respirator.
Riveting forge.
Rotary blower.
Speaking-tube whistle.
Steam fan.
Suction fan.
Traveling forge
Tube whistle.
Tuyere.
Vacuum chamber
Vacuum pump.
Vanner.
Vanning machine.
Ventilating apparatus
Ventilating cowl.
Ventilating light.
Ventilator.
Water aërating apparatus.
Wall ventilator.
Water column air-compressor.
Water tuyere.
Whistle.
Wind car.
Windmill.
Wind-wheel.
Workshop forge.

Air and Cir'cu-la'ting Pump. A steam-engine, which in addition to the duty of the air pump in condensing engines, pumps the water from the hot well into the boiler. See, for instance, the *Blake* combined air and circulating pump, "*Manufacturer and Builder*," * xii. 4.

Air Bag. 1. Air bags for raising sunken ships were tried by Captain Gowan on the wreck of the U. S. steamer "Missouri," in 1851, and again on

sunken Russian men-of-war at Sevastopol. In 1864 air bags were applied for raising a steamer sunk in the Lake of Boden; in this case the bags, owing to some defect, gave way. The Alexandrovsky system has rendered good service to the Government and commerce of Russia on several occasions.

"The bags adopted in the Russian navy are, when inflated, of cylindrical form, measuring 12′ in diameter and 20′ in length. They are composed of three layers of the thickest canvas saturated with India-rubber. Their lifting power averages sixty tons. In order to lift a vessel, several chains are drawn by divers under her bottom, and air bags attached to the ends of each of them as near the ship's bottom as possible: the bags, being inflated by means of air-pumps, cause the ship to rise. Before pumping air into the bags, all the chains are connected in a transverse direction, so as to form one system, thus preventing the pairs of bags from sliding off from beneath the hull of the ship. As the vessel rises the surrounding water-pressure decreases, and the excess of air passes out through safety-valves." — "*Engineering.*"

See, also, Fig. 4148, p. 1847, "*Mech. Dict.*"

2. (*Surgical.*) Specifically, Politzer's air bag for inflating the Eustachian canal and treating diseases of the middle ear. See *f*, Fig. 2678, p. 1185, "*Mech. Dict.;*" Fig. 1814, p. 869, *ibid.*

See, also, Figs. 179–182, 184, pp. 39, 41, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Air Box. (*Mining.*) A wooden tube used for ventilation in a mine when there is only one shaft.

Air Brake. (*Railway.*) A railway brake operated by air, either by the *compression* or *vacuum* method.

In the former, the air is compressed by a pump on the locomotive, and conveyed by pipes, and by flexible tubes between the cars, to cylinders under each car. Each cylinder has a piston which operates the brake levers.

The *Westinghouse* brake is an instance, and is described and represented on p. 356, "*Mech. Dict.*"

The *Loughridge* brake is similarly actuated.

In the latter form (vacuum), the air is exhausted from the device beneath the car, and the pressure of the atmosphere operates the brake-levers.

The *Eames* and *Smith* brakes are of this class.

See RAILWAY CAR BRAKE.

Air Bridge. An arrangement for injecting air at the bridge of a furnace, in the rear of the grate surface. Examples of bridges are numerous in Plate LXI., and page 2327, "*Mech. Dict.*"

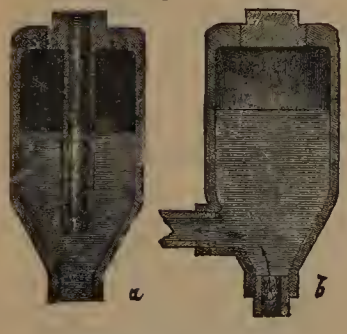
McMurray's corrugated-iron air bridge and fuel economizer, is shown in "*Scientific American,*" * xxxvii. 374.

Air Cam'el. A lightering device, consisting of a caisson placed beneath a vessel to diminish its draft of water to enable it to pass a relatively shallow channel.

The early use of the camel in Holland is referred to on p. 1874, "*Mech. Dict.,*" under the caption, RAISING SUNKEN VESSELS. See also AIR CUSHION.

Air Cham'ber. In Fig. 24, *a* is an air chamber to be placed over the suction cylinder in deep wells, the pump rod working through it.

Fig. 24.



Air or Vacuum Chamber for Pumps.

Also used as a vacuum chamber under a suction pump. With a force pump two may be used with advantage; one as an air chamber above, and the other as a vacuum chamber beneath the pump cylinder.

In the same Fig., *b* is a chamber to be placed where the elbow would be in the angle of the ascending suction pipe and the horizontal water pipe, or placed alongside of the pump when the situation should require it.

Air'-cock. A faucet to allow escape of air: as in the case of the air-cock, otherwise known as a pet-cock, to allow escape of air from the steam cylinder when starting the piston.

Fig. 25.

Air Cocks.

The figure shows the ordinary straight nose air-cock, and the bibb-nozzle air-cock.

See also CYLINDER COCK.

Air Com-press'or. Applications of compressed air: —

Static: Employed in a condition of permanent elasticity.

1. Air reservoir in pumps. Regulators. Diving bells.
2. Pneumatic piles and caissons. Tubular foundations.

Dynamic: Employed in movement.

3. Elevation of liquids; ejectors.
4. Displacement of liquids.
5. Blowers: rotary, collapsible, and piston.
6. Air-guns.
7. Air-pumps and compressors.
8. Ventilation by chimney draft (vacuum).
9. Compression, and transport of compressed gas.
10. Compressed air locomotives.
11. Pneumatic railway brakes, tubular dispatch, and telegraph.
12. Ventilation by injection of compressed air (plenum).

The air compressors at Mont Cenis, and Hoosac Mountain, are referred to on pp. 27, 28, "*Mech. Dict.*"

Under the caption "AIR AS A WATER ELEVATOR," various devices of the nature of ejectors are shown to the number of nine illustrations, embracing the famous device at Chemnitz, and many novel devices growing out of the deep oil-wells. See also Calles' AËRO-HYDRO-DYNAMIC WHEEL.

AIR-COMPRESSING MACHINES are shown on pp. 31–33, "*Mech. Dict.,*" both simple and compound.

Under COMPRESSED-AIR ENGINES, are shown the Gowan colliery engine of Glasgow and the Sommeilleur apparatus at the Bardonneche end of the Mont Cenis tunnel. The latter form of apparatus, depending upon the compression of air by the body of descending water, is maintained in the Colladon apparatus, yet in much favor on the Continent of Europe, in positions where water is abundant and fall sufficient.

The tendency, however, is to the steam-driven air-pump, of which one or two examples will be offered.

The Gowan colliery engine is also shown on p. 10, article *Air comprimé*, Laboulaye's "*Dictionnaire des Arts et Manufactures,*" Fig. 3321, Tome iv., edition of 1877.

The Modane air compressors of the Mont Cenis tunnel are shown and described in the last-mentioned work, Figs. 3322, 3323, and accompanying text.

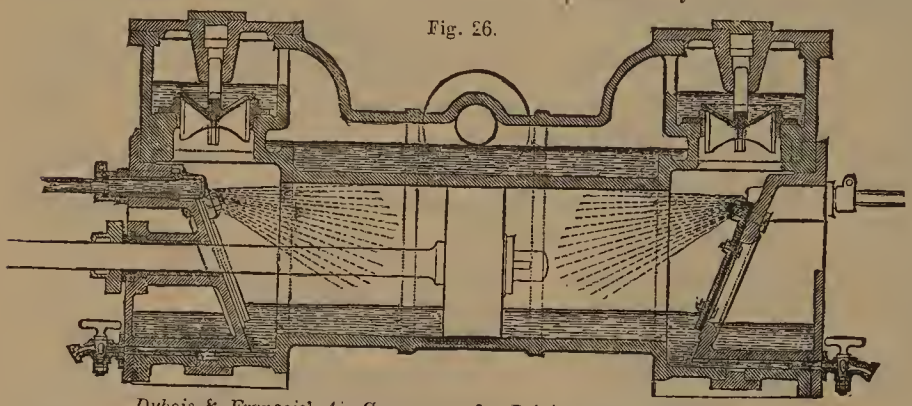
The compresscur Colladon is shown in the same work at Fig. 3324, article "*Air comprimé*," Tome iv., edition 1877. It was used at the St. Gothard tunnel.

Brunnin's water column, or air-compressor, is described in the "*Revue Universelle des Mines*," 1879, the article being reproduced in "*Van Nostrand's Engineering Magazine*," * xxi. 9.

The action of the machine is in two periods: the first consists in compressing the air in a closed cylinder by direct pressure of the water; the second, during which the water, having done its work, flows out. The compressor has a cylindrical reservoir with double seal valves of unequal diameter, one to admit the water, and the other to subsequently discharge it. Two other valves serve severally to admit fresh air and to discharge compressed air to a special holder.

The air-compressor designed by MM. Dubois and François, to drive drills for sinking shafts, is shown in Fig. 26.

Fig. 26.



Dubois & François' Air Compressor for Driving Shaft-sinking Drills.

"The arrangement consists of an air reservoir of 280 cubic feet capacity, of which from one fourth to three eighths is occupied by the injection water, and the remainder by the compressed air. Two iron pipes, 2″ in diameter, conduct the air to the drills, which are four in number, and on the Dubois and François system. The diameter of the cylinder is $3\frac{1}{2}$″, and the stroke $7\frac{7}{8}$″. The frame is formed of wood and iron, and has two vertical iron standards 3.9375″ in diameter; each standard carries a horizontal screw, and the drill is mounted on a nut moving on the screw, and having a range of half a circle. During the period of blasting and extraction of the spoil, the frame and drills are lifted, and when at work it rests upon a timber substructure. The compressor is intended to deliver air at a pressure of $3\frac{1}{2}$ atmospheres. It is actuated by a steam cylinder $29\frac{1}{2}$″ stroke and $13\frac{7}{8}$″ in diameter, and the piston-rod is attached direct to the piston of the compressor. The compressor cylinder has the same stroke and diameter as the steam cylinder, and the ends are inclined as shown in the section; they are fitted with two valves for the admission of the air, and at each end there are two gun-metal valves arranged as shown. Into each end of the cylinder there penetrates the perforated extremity of a pipe, and through these, at every stroke, water is injected against the piston and the sides of the cylinder to prevent the heating due to compression. The water is not allowed to accumulate beyond the level shown in the section, an overflow being provided, operating automatically. The following advantages are claimed for the arrangement: 1 The area of the inlet valves is very large. 2. The water injection ceases at the moment when it becomes unnecessary, that is to say, when the air reaches in the cylinder the same pressure that it has in the reservoir. 3. The compressor may be worked at a speed from 40 to 50 strokes per minute. At the coal mines of Wérister it was used in sinking two shafts, each 656 ft. deep, and the results of working with this system have been highly satisfactory."—*Revue Industrielle.*

The Clayton duplex air compressor, shown in Plate I., has two horizontal steam cylinders and two air cylinders, securely bolted on a very strong frame, the steam pistons communicating most of the power through the yokes to the compression pistons. The fly-wheel is placed between the two compressors, and on each end of the fly-wheel shaft is a crank, which cranks are set at right angles to each other, so that when the full compression of the air is attained in one compressor the opposite crank exerts its full force to complete the strokes, thus giving an even and uniform motion without any danger of the machine sticking on the center.

In the later form shown in the plate, a connecting rod is substituted for the former sliding journal boxes (shown in Fig. 1524, p. 650, "*Mech. Dict.*"); the yokes are connected at top by a rod, and at the bottom by a distance piece which serves as a slide, working on a long slipper guide which is adjustable and is placed inside the frame to relieve the cylinders from the wear incident to the weight of the pistons, rods, and connections.

The steam and air cylinders are united by tension rods above. The engine is duplex, the two portions acting upon the same crank shaft, the fly-wheel on which occupies the center of the machine. The air cylinders are cooled by the application of water in jackets so arranged that the cold water is first brought in contact with a portion of the top, and then forced around the extreme ends of the cylinders where the heat is greatest, the water then traveling upward around the center or cooler portion of the cylinders.

The adjustable tripping device can be set to lift the discharge valves at any point in the stroke, affording free escape for air in the cylinder as soon as it has reached the working pressure. The air governor can be set to any pressure desired, and will not allow the pressure on the rock drills or other machinery to vary, notwithstanding the pressure of steam or the number of drills at work. See Fig. 27.

The lubricating valve supplies the air cylinders at each stroke with a fixed amount of lubricating fluid.

The engines are disconnectable, so that one only may be worked when necessary for repairs or for other reason.

The "*Mining Journal*" (British), 1877, has a discussion on the respective constructions and uses of several air compressors; the article is in part reproduced in "*Scientific American Supplement*," * p. 1491.

It describes the "Moonta," * named from mines in South Australia, and in use in the Isle of Man, and in Cornwall; the "Flower" compressor, used at the Powell Duffryn Colliery, South Wales, and the "Festiniog"-tunnel compressor. It also refers to the cost, and some points in connection with the following air-compressors: —

Sommeiller. Colladon.
Cockerill Foundry.

The following references to air-compressors may also be consulted: —

Bowers . . . . . * "*Iron Age*," xix., April 26, p. 9.
* "*Eng. & Min J.*," xxv. 56.
* "*Scientific Amer.*," xxxvii. 15.
Brunnin . . . . . "*Iron Age*," xxiv., July 20, p 13.
Fr. (water column) . * "*Van Nostrand's Mag.*," xxi. 9.
"*Revue Universelle des Mines*," 1879.
Burleigh . . . . . * "*Eng. & Min. J.*," xxii. 183.

Clayton	* "*Man. & B.*," ix. 9; * xii. 9; * xii. 100.
	* "*Technologist*," Feb., 1877.
	* "*Scientific American*," Feb., 1879.
	* "*Iron Age*," xix., May 3, p. 1.
	* "*Iron Age*," xxii., Sept. 19; Dec. 19, p. 1.
	* "*American Manufact.*," Jan. 9, 1880, p. 13.
	"*Engineering and Min. J.*," Sept. 14, 1878.
Colladon	Article "*Air Comprimé*," Fig. 3329, "*Laboulaye's Dictionary*," vol. iv.
Cranston, Br.	* "*Engineering*," xxii. 320.
	"*Scientific American Sup.*," 837.
Dubois & François	* "*Engineering*," xxi. 249.
	* "*Scientific American Sup.*," 349.
	* "*Revue Industrielle*," 1876.
(duplex)	* "*Scientific American*," xli. 410.
Ericsson	* "*American Artisan*," March 18, 1874.
Ferroux	"*Scientific American Sup.*," 311.
Frizell	* "*Scientific American Sup.*," 1460.
Genesee Falls	"*Scientific American*," xlii. 313.
Gowan Colliery, Glasgow	* "*Laboulaye's Dictionary*," iv., Fig 3321.
Guild & Garrison	* "*Scientific American*," xxxvi. 310.
Hathorn, Br.	* "*Engineer*," xlvii. 116.
	"*Iron Age*," xx, Nov. 29, p. 7.
	"*Mining Journal*" (Br.), Nov. 2, 1877.
Ingersoll	* "*Min. and Sc. Press*," xxxvii. 177.
Normandy Stillwell & Co.	* "*Engineer*," xlvii. 352.
Factory at Norwalk	* "*Scientific American*," xlii. 367.
Norwalk (compound)	* "*Eng. and Min. J.*," xxx. 141.
Patton (water elevator)	* "*Min. and Sc. Press*," xxxviii. 25.
Rand	* "*Eng. and Min. J.*," xxx. 283.
Rand & Waring	* "*American Artisan*," Feb. 15, 1873.
Rider	* "*Iron Age*," xviii., Nov. 23, p. 1.
	* "*Engineer*," xlii. 263.
Robey, Br.	* "*Engineer*," xlii. 129.
	* "*Scientific American Sup.*," 774.
Royce	* "*American Engineer*," Nov. 1874.
Sawtell	* "*Scientific American*," xxxv. 390.
Sommeiller, Modane	Article "*Air Comprimé*," "*Laboulaye's Dictionary*," Fig. 3322, vol. iv.
Steel (Treatise), Br.	* "*Engineer*," xli. 473.
Sturgeon, Br	* "*Engineering*," xxviii. 51.
	* "*Iron Age*," xxiii., Jan. 9, p. 1.
Sutro Tunnel	* "*Engineer*," xlix. 96.
Wetter-on-the-Ruhr, Ger.	* "*Engineering*," xxx. 185.
Wyllie, Br.	* "*Engineering*," xxi. 517.

See: —
Zahner's "*Transmission of Motion by Compressed Air.*"
Pernolet's "*L'Air Comprimé.*" Paris, 1876.
Drinker's "*Tunneling, Explosive Compounds, and Rock Drills.*" New York, 1878.

Air'-cool'ing Ap'pa-ra'tus. See AIR-REFRIGERATING APPARATUS; ICE-MACHINE.

Air'-cross'ing. (*Mining.*) An arch built over a horse-way or other road, with a passage or air-way above it.

Air Cush'ion. Air cushions, distended, serving to support a vessel upon a camel or shallow-water ship-float, are shown in "*Engineering*," * vol. xxiii., p. 369; and the same device applied to graving-docks, * on p. 511 of the same volume. The invention of the engineers Clark and Standfield.

The cushions are composed of layers of canvas and rubber, capable of resisting a strain of about 40 lbs. to the inch, and they are inflated by means of air compressors worked by engines at the side of the dock. They are protected outside with rope matting. The form of the bag when inflated resembles a bellows with a cushioned top, and the lower expanding section has inlet and relief pipes, the latter employed to allow the air to escape after a given pressure has been exceeded. Access to any part of the ship's bottom can be gained by allowing the air to escape from one or more bags, and so making it clear of the ship, while the latter is supported by the adjacent cushions.

Air Cyl'in-der. One in which air is the moving power to operate a piston, or is acted upon by the moving piston.

Such are found in various engines and devices: —

Air engines.	Air cylinders of car-brakes.
Air compressors.	Compressed-air engines.
Caloric engines.	Air-pumps.
Hot-air engines.	

Some of which names are synonyms.

Air'-drain. (*Add.*) 2. (*Molding.*) A large passage, often of considerable length, to conduct the gases safely from heavy castings deeply bedded in the floor of a foundry.

Air En'gine. An engine driven by heated air.

The air engine of Woodbury, Merrill, Patten & Woodbury, patents June 8, 1880, heats and cools the same air alternately. It has two working cylinders, 10″ diameter × 24″ stroke, and two reversers, 20″ diameter × 12″ stroke. The essential features of the engine are a heater, regenerator, and cooler, which three in combination are termed a *reverser*, and, in conjunction with a *working cylinder*, constitute a single acting engine. The rapid heating and cooling of the air is necessary with each stroke, and the rapidity with which this is accomplished is one of the peculiar excellences of this machine. The heating is by fuel in the furnace; the cooling by the circulation of water around small, thin copper tubes through which the air passes. See HOT-AIR ENGINE.

The term *air engine* has become somewhat general, and instances of one class are given under

Caloric engine,
Compression engine,
Hot-air engine,

and of another under

Compressed-air engine,
Air compressor, etc.

See list under AIR APPARATUS.

Air E'qual-i-zer. A device to distribute a blast of air equally throughout the working space in a machine, to prevent its tendency to establish a central current and prove inefficient at the sides of the chamber.

See, for instance, *Shaver's* device in middlings-purifiers, * "*American Miller*," viii. 2.

Air Fil'ter. A protective ventilator consisting of a cloth interwoven with thin brass wire to act as a filter for the air. It is to be attached to the upper and lower sashes so as to close the openings.

Gaston Tissandier has made some investigations into the quantity of dust contained in 35.3 cubic feet of air, by causing that quantity of air to pass through a tube packed with gun-cotton, which filters out the particles. He then dissolved the gun-cotton in ether, and was thus enabled to obtain the particles in a separated condition. After a heavy rain, M. Tissandier has collected 0.09 of a grain of dust in the above-mentioned quantity of air, but in dry weather this proportion rose to 0.3 of a grain. With regard to the nature of the material, he found that about one third was organic, one third silicious, and the rest composed of various substances.

"*Iron Age*," xxi., January 24, p. 19.
See instances, Figs. 95–100, pp. 46, 47, "*Mech. Dict.*"

Air Fur'nace. (*Metallurgy.*) One depending upon the draft of a chimney, as distinct from a *blast* furnace. A *wind* furnace.

Air Gage. A manometer to indicate the pressure of air or gas in a vessel or chamber.

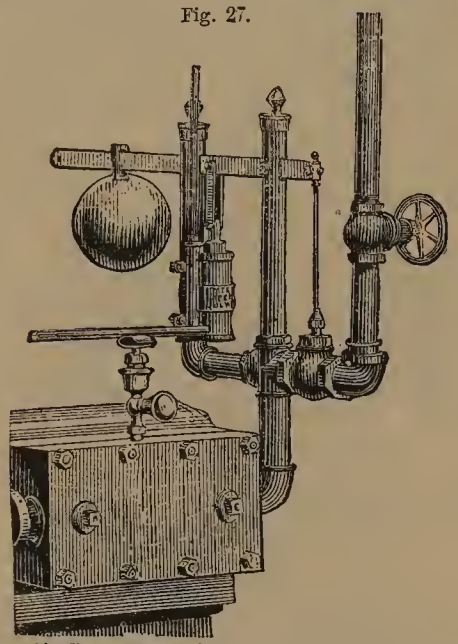
It is sometimes similar to a steam gage, but in other instances, such as the piezometer, it serves to register enormous pressures of gas in the explosion of charges of powder. See list under "MEASURING AND RECORDING APPARATUS," *infra*.

Air'-gas Ap'pa-ra'tus. Another name for the Carburetor, in which coal-gas or air is passed through a volatile hydro-carbon to increase or confer the illuminating power. See CARBURETOR, p. 464, "*Mech. Dict.*"

Air Gate. (*Molding.*) An opening direct from a large mold, through which the displaced air escapes at the time of pouring, and in which the metal afterward rises. A *riser*.

Air Gov'er-nor. An instrument attached to an air-compressor, or blowing engine, to regulate the pressure of air in rock drills, blast furnaces, etc., where a uniform pressure of air is desirable. The

Fig. 27.



Air Governor on Air-compressing Machine.

air governor may be set to any desired pressure, and operates to turn off the steam from the steam cylinder when the air pressure rises too high, and turns on more steam when the air pressure goes down. See also AIR-SPRING GOVERNOR.

Air Gun. A compact and elegant form of the air gun, in which the whole of the hollow sheet-metal butt is utilized as an air reservoir, charged by a piston in the barrel, may be seen in *Laboulaye's* "*Dictionnaire des Arts et Sciences*," Article "*Air Comprimé*," Tome iv., Figs. 3317–3319, edition of 1877.

In the same article is the device by M. Bourdon for testing the force of the blow delivered by the bullet from an air gun, Fig. 3320.

Hyde's Air Gun, "*Scientific American*," * xliii. 134.

Air'-head. (*Mining.*) A channel driven on a level with the top of the gate road, about four yards distant therefrom.

Air Heat'er. Generally: a device to heat air, as in a HEATING STOVE or HEATING FURNACE, which see.

Specifically: a device to heat air to feed furnaces, whether heating or metallurgic. The Siemens, Ponsard, Bicheroux, and other furnaces of the class, have regenerators to heat the incoming air. See GAS-GENERATING FURNACE, REGENERATOR, AIR ENGINE, etc.

Thonger's air heater, for locomotive furnaces, is shown in "*Scientific American*," * xxxv. 102.

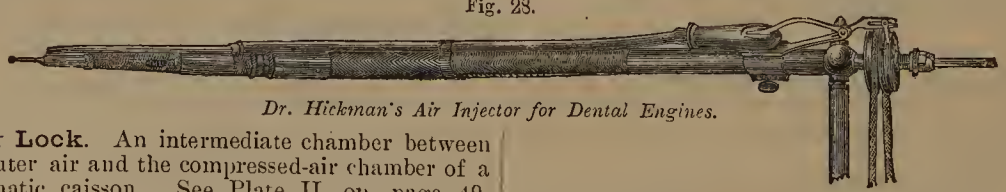
The *Boswell* air heater, for stoves, furnaces, laundries, fruit dryers, etc., is shown in "*Mining and Scientific Press*," * xxxvii. 281.

Air heater by waste gases, * "*Engineer*," xlviii. 321.

Air In-ject'or. A blowing device to throw a jet of air. Such are found in atomizers, in some classes of fine sawing machines, to blow away the dust, and, as in the instance shown, in connection with dentists' burring engines.

A rubber bulb is compressed automatically by means of a simple mechanism, which is connected with and worked by the driven pulley. The air is forced from the bulb through the connecting rubber tube to a fixed nozzle at the hand-piece, whence it is thrown into the cavity of the tooth. The air thus driven out of the bulb leaves a vacuum which is instantly filled again with air from the patient's mouth. This alternate exhaustion and supply is kept up so rapidly, even at the ordinary speed of the pulley, that the air is injected in a continuous stream into the cavity. This appliance operates to keep the cavity clear of bur-dust and cuttings, and also to keep the bit cool while in use.

Fig. 28.



Dr. Hickman's Air Injector for Dental Engines.

Air Lock. An intermediate chamber between the outer air and the compressed-air chamber of a pneumatic caisson. See Plate II., op. page 49, "*Mech. Dict.*," and Figure 1021, page 421, *ibid.*

The air lock is the subject of a paper in the "*Annales des Ponts et Chaussées*," reproduced in "*Van Nostrand's Magazine*," vol. xxii., p. 151, *et seq.* The paper is by M. A. Heincrcheidt, and particularly concerns an improved closing port for the discharge in lock. It is well illustrated.

See also article "*Air Comprimé*," in *Laboulaye's* "*Dictionnaire des Arts et Sciences*," Tome iv., Figs. 3314–3316, edition of 1877.

Also air lock and dredging apparatus. Prague. * "*Engineering*," xxix. 14.

Air Lo'co-mo'tive. A locomotive driven by heated air or compressed air, usually the latter.

See COMPRESSED-AIR ENGINES; STREET CAR MOTORS, etc.

See notices on p. 603, "*Mech. Dict.*," of

Bompas, 1828. *Parsey*, 1847.

Also, on pp. 2422–2424, *ibid.*, of

Medhurst, 1800.
Bompas, 1828.
Wright, 1828.
Mann, 1829.
Surrey, 1856.
Pinkus, 1834–39.
Turnbull.
Fontainemoreau, 1844.
Anderson, 1846.
Fell, 1847.
Van Rathen, 1847
Johnson, 1856.
Creever & Keeney, 1859.
Smith, 1871.
Bowen, 1873.

The air locomotive of Major Beaumont, R. E. (British), was lately tried (1880).

"The engine having received a charge of 100 cubic feet of air, with a pressure of 1,000 pounds to the square inch, left the Royal Arsenal station, on October 6th, at 12.22 P. M., for a run to Dartford and back, about 16 miles. In order to increase the energy of the air, it was heated, on being admitted to the cylinder, by a very small quantity of steam. The indications on the pressure-gage, as different stations were passed, were 940 pounds at 12.27 P. M.; 860 pounds at 12.33, and 760 pounds at 12.40; 540 pressure being the store of energy on arriving at Dartford at 12.50. Waste having been occasioned by shunting, the return journey began with a pressure of 510 pounds at 1.35 P. M., and Plumstead station was again reached at 2.10. This locomotive, not so large as

one of our common street-cars, weighs about 10 tons, and draws a load of 16 tons up a moderate incline. It can be charged with air in fifteen minutes, does not send out any rush of steam or noxious gases, and makes only a trifling noise. Its sanitary advantages for underground work are obvious, and it can also be used for surface roads."—*British Paper.*

The compressed-air locomotive (model) of the "Polytechnic College of Philadelphia," is noticed in "*Scientific American Supplement*," p. 624.

See, also, Official Reports of Paris Exposition of 1878, vol. iv., p. 461, Commissioner Anderson's Report, for

* *Mekarski's* compressed-air motor.

* *Lamm-Francq's* fireless locomotive.

See, also, for *Mekarski's*, "*Scientific American*," *xxxv. 82.

Air Me'ter. An instrument for measuring the rate of motion of an air current; used in mines, hospitals, etc.

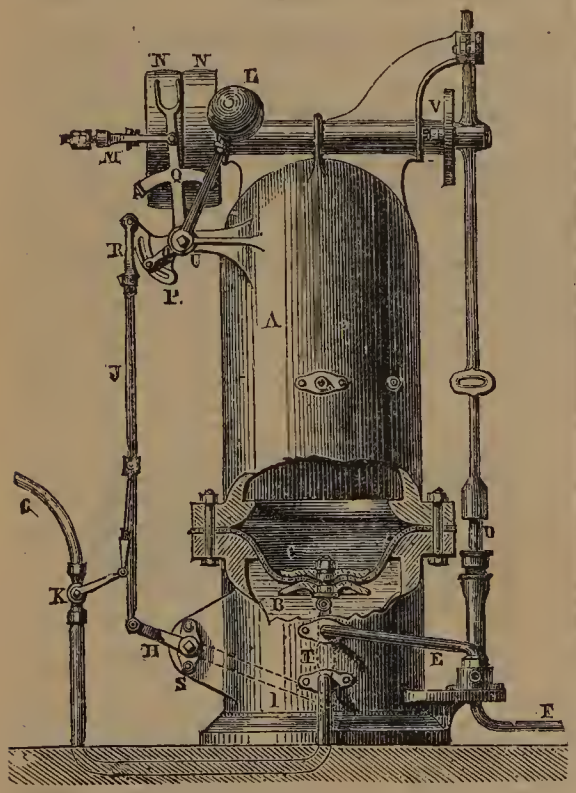
Casella's air meter is shown under ANEMOMETER, which see.

Air Mois'ten-er. An evaporator exposed to the heat of a stove, heating pipes, or radiator, to impart moisture to the atmosphere. See EVAPORATOR.

Air Pis'tol. A small weapon differing in no substantial respect but size and portability from the air gun.

Air-press'ure Reg'u-la'tor. An instrument for preserving an even pressure in pneumatic apparatus.

Fig. 29.



Air-pressure Regulator.

A, Chamber filled with air at the desired pressure.

B, Space filled with water.

C, Caoutchouc membrane separating the air from the water, and lifted by the levers *H I* by means of the rod *T*.

D, Pressure pump, with its supply and discharge-pipes *F E* respectively.

G, Water-pipe leading to the machines in communication with the chamber.

H, Two-branched exterior lever. } In prolongation on the same axis, the journals of which are packed in the box *S*.
I, Single interior lever. }

J, Rod terminating in a cap-piece *R*, and connecting the slotted sector-guide *P* to the lever *H*.

K, Regulation cock, moving automatically by means of its lever and a link connecting it to the rod *J*. Its purpose is to prevent overstrain of the caoutchouc diaphragm when the latter is at its farthest depression.

L, Counterpoise on the belt-shipping lever axis *V*.

O, Levers fixed on the axis *V*, and connected at their ends by a gudgeon traversing the slot of the sector *P*.

P, Sector-guide loose on the axis *V*.

Q, Forks loose on the arbor *V*, jointed to the piece *M*, which limits their movement.

N N', Fast and loose pulleys on the axis of the eccentric *V*, which works the pump rod.

The cut represents the diaphragm near the end of its downward extension. The cock, *K*, is nearly closed, and allows passage to the minimum quantity of water.

In the disposition of parts exhibited in the cut, the pump is about to start; the ball *L*, in consequence of the position given to the levers, *O*, by the sector *P*, has passed the vertical, and is about to draw on the belt fork, and bring the belt upon the fast pulley *N*.

The pump continues to work until the raising of the diaphragm by excess of water shall act inversely, by the connections already cited, upon the ball *L*, and shift back the belt to the loose pulley, *N'*.

Air'-pump. The uses of the air-pump have largely multiplied since its invention by Otto von Guericke.

Fig. 30.

Otto von Guericke's Air-pump, and the Magdeburg Hemispheres. (*From a recent photograph.*)

The original pump, lately brought to light at a loan collection, is 5′ high; the hemispheres are 26″ diameter; two receivers form a part of the group.

See Father Schott's "*Technica Curiosa.*"

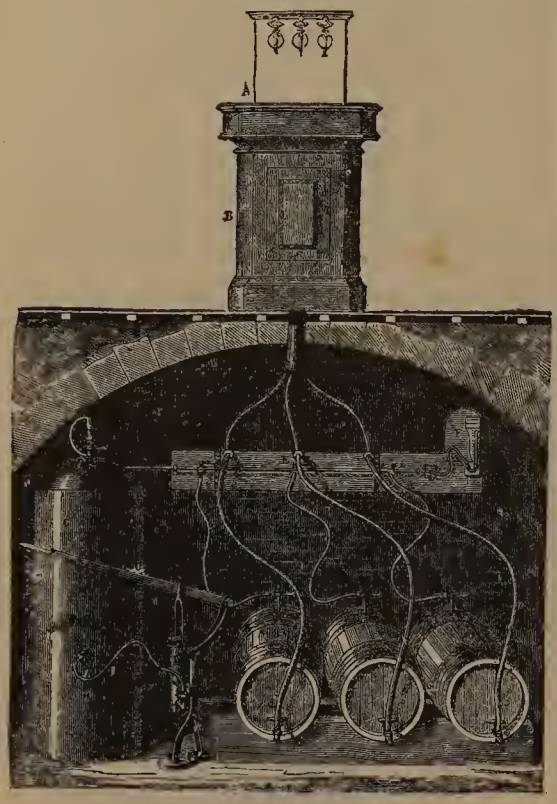
1. The air-pump used by divers has usually three cylinders and three single-acting pistons, operated by a three-throw crank. A form manufactured in Boston is shown under SUBMARINE AIR-PUMP. See AIR COMPRESSOR, DIVING-BELL, RESPIRATOR, etc., "*Mech. Dict.*"

2. The air-compression pump of the Westinghouse air-brake has a steam cylinder and air cylinder placed in line, and with piston-rod connecting the two pistons. The steam and air admission and exhaust of the respective cylinders are governed by valves in the passages. See RAILWAY-CAR BRAKE.

3. The air-pump used in carburetors is usually a form of meter wheel, or a device like the tympanum. See pp. 464 *et seq.*, "*Mech. Dict.*"

4. An air pump used for beer fountains is shown in Fig. 31. It is somewhat of a refinement upon the mere lift-pump leading from each cask to the dispensing tap at the counter.

Fig. 31.



Compressed-air Beer-pump.

A single pump, *D*, condenses air in a cylinder, *C*, which connects by pipes to the spile-hole of each cask. From the faucet of each cask proceeds upwardly a pipe through the case *B*, to the dispensing table *A*. *F* is a manometer, to indicate the pressure.

Arrangements on similar principles are used in France in cellars and wine-vaults for transferring and racking wines; for heating them on the new process, to give the quality of age, etc.

Air-pumps of this class are largely used in the United States in breweries and other factories, where quantities of liquids are to be moved. For this purpose direct pressure of air is more manageable and convenient than the ordinary liquid pump of whatever class. They are classed as *air-pumps* up to a pressure of thirty pounds.

5. Air-pumps for a pressure exceeding thirty pounds per square inch are known as *air-compressing machines*, which see. The air locomotive of Colonel Beaumont, of Woolwich, England, is said to start with a reservoir filled at a pressure of 65 atmospheres, while the Dubois and François air compressor delivers air to the rock drills at 3½ atmospheres.

6. Blowers may be classed as air-pumps, but whether for urging fires or for ventilation, their force is usually far inferior to that of the ordinary air-compressing engines, for the service of rock drills, for instance.

7. *Geissler's* air-pump without valve, as improved by MM. Alvergniat Frères, of Paris, and which suppresses *l'espace nuisible*, is shown with illustration on p. 491, vol. iii., of the "*Reports of Paris Exhibition*" of 1867. Succeeding pages describe

* *Kravogl's* mercurial air-pump.
* *Richards'* valveless air-pump (Plate VIII.).
* *Delewils'* free-piston air pump.
The *Sprengel* air-pump is shown at Fig. 393, p. 170, "*Mech Dict.*"

8. The independent air-pump is one driven by another motor, in place of being actuated by a crank on the main shaft. Such an air-pump is sometimes used in connection with a condenser, and being independent, a vacuum may be formed before it is started.

Otherwise the air-pump is combined with a circulating pump which takes the water from the hot-well and sends it to the boiler.

9. (*Surgical.*) Air-pump for cupping; Fig. 195, p. 64, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Junod's boot and arm for dry cupping. *Ibid.* Figs. 176, 177, pp. 112, 113, Part IV.
Air-pump for spray producer and atomizer. *Ibid.* Fig. 364 *b*, p. 89, Part II.
See also AIR-PUMP, p. 50, *et seq.*, "*Mech. Dict.*" ASPIRATOR, pp. 169, 170, *Ibid.*

The following references may be consulted:—

Air-pump.	*Otto Von Guericke*	* "*Sc. Am.*," xl. 70.
	Simple. *Hopkins*	* "*Sc. Am.*," xl. 35.
	Moll	* "*Sc. Am.*," xxxiv. 371.
	Weindel	* "*Sc. Am.*," xxxv. 246.
	Sprengel	"*Sc. Am.*," xxxvii. 343.
Air-pump and Condenser.	*Tangye*	* "*Engineering*," xxii. 51.
Air-pump Condenser (Engl.)		* "*Sc. Am. Sup.*," 1731.
Air-pump for supplying air-vessels of pumps.	*Wipperman & Lewis*	* "*Engineer*," xlviii. 462.
Air-pump "Niagara," Duplex		* "*Sc. Am. Sup.*," 499.
Air-pressure acid pump.	*Wyllie* (Br.)	* "*Sc. Am. Sup.*," 524.

Air-re-frig'er-a'ting Ma-chine'. A machine constructed by Hall, of Dartford, England, for refrigerating the hold of an Australian meat-ship, has a pair of horizontal trunk-engines mounted on top of a condenser. To one side is bolted a compressing cylinder, 27″ diameter and 18″ stroke; to the other side is bolted the expansion cylinder, 22″ diameter and 18″ stroke. Both these cylinders are open-topped. The valves are placed in the bottoms of the cylinders, and are worked by cams on the crank-shaft and levers. Air is drawn into the compressing cylinder on the up-stroke, and delivered on the down-stroke into the surface condenser, at a pressure of about 50 lbs. to 55 lbs. on the square inch. The air here parts with its heat in the condenser, and it is then delivered into the expansion cylinder, the valve of which cuts off at about one fourth stroke. The expanded air is then delivered through a pipe into the room to be cooled. About fifty per cent. of the work expended in the compressing cylinder is returned in the expansion cylinder, the difference being made up by the engine. In the form recommended for ordinary use, the height is kept down to render it specially suitable for the space between decks; but the machine can be made to take almost any form, and can be made of any dimensions to suit particular requirements. The condenser or refrigerator consists of nests of brass tubes, through which the water circulates. The tubes have an outside diameter of ½″, and are accessible through man-holes.

See illustration in "*Sc. Am. Supplement*," p. 4039. See also *ibid.*, 4011. See also * "*Engineer*," l. 248. See REFRIGERATOR.

The apparatus of MM. Nezereaux and Garlandat has a perforated plate, over which a body of cold water runs, while a body of air, driven by a fan, courses through the holes, and acquires within a few degrees the temperature of the water. — "*La Nature.*"

See also "*Scientific American*," xxxiv. 82.

By the use of an air-compressor, with tanks and cisterns, the temperature of a given space may be readily reduced nearly to the freezing point, if desired. Many processes, primarily intended for pro-

ducing ice, are available for air-refrigerating purposes.

See AIR-COOLING APPARATUS; ICE-MACHINE; in former volumes.

The following United States patents may be examined: —

Nos.	Nos.	Nos.	Nos.
39,456	211,700	162,920	138,411
193,830	226,908	102,660	14,510
164,421	191,232	195,374	184,291
229,374	87,041	44,731	175,291
149,980	151,515	227,796	168,654
233,072	209,892	140,375	139,470

Air Res'er-voir. The reservoirs constructed by Dr. C. W. Siemens, for Colonel Beaumont, of Woolwich, Britain, to be used in his air locomotive, and withstand a pressure of 1,000 lbs. to the square inch, are made of cylindrical rings of steel rolled out of solid ingots in a tire-mill, and hemispherical ends beaten out of steel boiler-plate.—*Paper before "Institution of Mechanical Engineers"* (Br.), 1878. Reproduced in *"Scientific American Supplement,"* * 2033.

The Matthews' reservoirs of similar shape made for carbonated waters, and used as reservoirs for carbonic-acid gas in the United States torpedo service, are made of volutes of sheet steel, coated with tin, and sweated together. See description on p. 2237, *"Mech. Dict."*

A peculiar arrangement of air reservoirs in pumps, to totally exclude the shock, is shown in *"Dinglers' Journal,"* and reproduced in *"Scientific American,"* xxxvii. 329.

Air'-spring. A spring in which the elasticity of air is utilized in place of metallic or other material.

1. The air-spring used in a reciprocating flat bed printing-press, to stop and reverse the movement of the bed, is a very important improvement over the wire spring, being almost indispensable for high rates of speed. To overcome the momentum of the bed of a 32″ × 46″ drum cylinder press with a full form of type running at the rate of 1,600 impressions per hour, is calculated to require about 2,550 pounds of resistance on each center.

Fig. 32.

Air-spring for Bed of Printing Press.

The air-spring is used on the presses of several of the superior makers. The press spring shown in Fig. 32 has a governor attachment, by which, when the press is started, the air-spring is automatically put on, according as the feed progresses, and in stopping the spring power is decreased as the feed declines. The bed is provided with two cylinders to engage with as many plungers at the ends of the frame, and the hollow rods of these plungers are connected by a pipe running along the lower part of the frame; which pipe is opened or closed by the valve of the governor. (See next article.)

The plunger has a hollow rod and an automatic valve at its extremity. This valve rises on the return motion of the bed, and prevents a vacuum forming in the cylinder. Fig. 32 shows a longitudinal section of the device.

2. Air-springs are also used in gun carriages to arrest the recoil of the gun; or to utilize the recoil of the gun to assist in elevating the gun in battery, after being depressed for loading.

Notices are given on p. 1035, *"Mech. Dict.,"* of the invention of Eads (1865–1871).

Moncrieff has another form. See HYDRO-PNEUMATIC GUN-CARRIAGE.

3. The use of the air-spring in car-springs is shown in Figs. 3852, 3853, p. 1755, *"Mech. Dict."*

4. The air-spring is used in the spring hammer of Hotchkiss, air being used as the elastic medium, holes in the reciprocating cylinder allowing free ingress and egress of air, insuring a perfect cushion at each stroke.

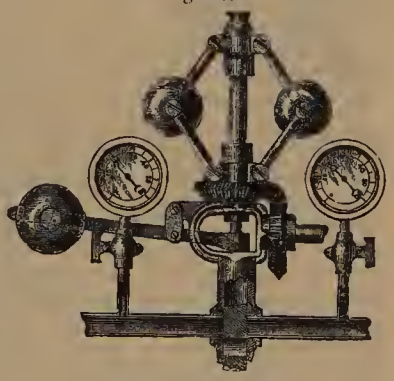
U. S. PATENTS FOR AIR AND PNEUMATIC SPRINGS.

4,965	Pneumatic Spring (Railway).
9,107	Car Spring.
13,248	Pneumatic Spring (Carriage).
19,764	Pneumatic Spring (Railway).
24,184	Air Spring for Cars and Wagons.
32,848	Pneumatic Spring (Carriage).
51,956	Pneumatic Spring for Cars, etc.
65,135	Pneumatic Spring (Railway).
70,177	Pneumatic Spring (Railway).
83,043	Air Spring (Railway).
87,307	Pneumatic Spring (Railway).
90,657	Air Spring (Railway).
111,303	Pneumatic Spring (Railway).
111,438	Pneu. and Rubber Spring (Railway).
125,749	Pneumatic Spring (Railway)
139,346	Automatic Vent-opener for Air-springs

Air'-spring Gov'er-nor. An attachment to an air-spring arrangement to regulate the pressure.

The instance illustrated represents the governor attached to an improved form of flat-bed printing press, to regulate the pressure of the air in the recoil spring. Fig. 33 shows the governor attached to the connecting pipe, with the plug valve, which it operates, and two spring gages to indicate the amount of condensation in the cylinders. The valve is shut by the motion of the press when running at speed, and is open when the press is at rest. This enables the press to be started at any point without helping it over the centers by hand. The spring gages indicate the pressure in the air cylinders, and this is determined by setting the plungers backward or forward on their rods, readily adjusting the amount of spring to the speed of the press. The press is furnished with a table showing the gage pressures indicating the amount of spring required for the different speeds run. The workman simply adjusts the plungers until the gages indicate the pressure laid down on the table.

Fig. 33.



Air-spring Governor.

Air Strain'er. A gauze or perforated plate to prevent ingress with the air, of dirt, dust, or insects. Such are used with the pump of the railway air-brake, in filtering the air for ventilation, etc.

See also AIR FILTER.

Air Tel'e-graph. A mode of communication known in France under the name of Sonnerie télégraphique, système Sparre. The principle is, that a compression of air produced by the pressure on or squeezing of an India-rubber ball at one end of

a long tube (generally a leaden pipe) is immediately transmitted to the other, and there makes audible signals. This mode of telegraphing is used in hotels, manufactories, vessels, etc., for limited distances.

Generally known as *Pneumatic telegraph*, and illustrated by Fig. 3854, on p. 1755, "*Mech. Dict.*"

Air Test'ing. To detect the presence of miner's fire-damp, various instruments have been employed. See FIRE-DAMP DETECTOR; GRISOUMETER.

Professor Wanklyn and W. J. Cooper have brought before the Sanitary Institute of England a new process for testing air. A strongly alkaline solution of permanganate of potassium is prepared, the strength of which is determined accurately. They allow a known volume of this solution to act on a given volume of air heated nearly to the temperature of boiling water. After allowing the solution to act on the air they again determine the strength; the loss of strength represents the amount of oxygen consumed by a known volume of air. The purer the air the less the consumption of oxygen.

Air Ther-mom'e-ter. In a loan collection of scientific apparatus lately exhibited at the "South Kensington Museum," London, the air thermometer of Galileo was shown. It was substantially like that of Santorio, of Padua, shown at Fig. 116, p. 53, "*Mech. Dict.*" The illustration in the "*Illustrated London News*" of the period is reproduced in "*Scientific American Supplement*," p. 742.

The same work, at p. 3929, gives an account of Witz's air thermometer.

For Winstanley's air thermometer, see "*Engineering*," * xxx., 459.

Air Trap. A device in a conduit to allow air to escape at the more elevated portions where it passes over summits.

A stop-cock, to be used as occasion may require, is the simplest form, but automatic appliances have been invented. That of Felix (French), used on the pipe-lines for the conveyance of beet-juice, is an iron bell tested to 15 atmospheres, placed at an elevated point on the pipe, where it is adjusted by two opposite tubulures soldered to its lower part. In the center is a pump cylinder in which slides a piston, the rod of which passes through the summit of the bell and communicates motion to a safety-valve. The air rises to the summit of this, passes into the cylinder, and gradually exercises a sufficiently strong pressure upon the piston to cause it to descend and open the escape-valve. A large portion of the air is ejected, the piston rises and closes the valve, and so on.

Air Valve. A valve to regulate the admission or egress of air.

1. Such are used in bends and traps of water-pipes to allow escape of accumulated air; as in *a* of Fig. 34.

Fig. 34.

Air Valves.

2. A valve to be operated by a float to close a pipe communicating with a cistern (*b*).

3. A screw valve, *c*, to close the opening of an air reservoir; such as an air cushion, for instance.

4. An automatic air valve is shown in Fig. 35. It consists of an oblate spheroidal disk placed in a chamber, and having attached to its radial axis a valve, which has its seat in the passage to be guarded. Changes in the heat of the disk chamber affect the oblateness of the disk and move the valve toward or from its seat. Expansion by heat acting in greater degree upon the exterior surface decreases the oblateness and shuts the valve opening. A curved plate would act similarly. A plate of two metals of unequal expansibility by a given degree of heat would do the same without being normally curved. See instances of thermostatic arrangement in LOW-WATER ALARMS (2), *D E* of Fig. 3008, p. 1359, "*Mech. Dict.*" See, also, THERMOSTAT, pp. 2551, 2552, *Ibid.*, especially Fig. 6374, p. 2552.

Fig. 35.

Self-acting Air Valve.

Al'a-bas'ter Im'i-ta'tion. Coat a statue of plaster-of-paris, or of papier-maché, with thick white damar varnish, and then dust with a pulverized glass.

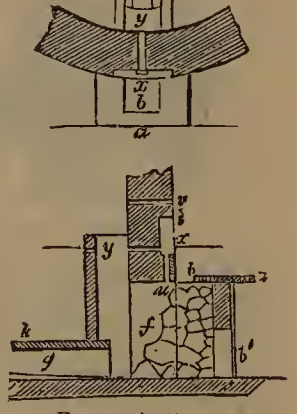
To give it the appearance of Carrara marble, varnish it a second time, and dust it with coarsely pulverized white glass or mica. If the marble veins be first traced on it with some delicate blue pigment, the imitation will be enhanced.

Paraffine wax makes a fine imitation of alabaster.

Another recipe for imitating alabaster ornaments prescribes brushing over plaster-of-paris models with spermaceti, white wax, or a mixture of the two, or steeping the models in the warm mixture. Or instead of this process, they may be brushed over several times with white of egg, allowing each coating sufficient time to dry.

A-lan'dier. (*Ceramics, French.*) A species of fire-place, of which several are placed around the base of a porcelain kiln, fed from the outside. Some of them have a downward draft on to the fire, from which the flames are conducted into the body of the kiln; others are ordinary furnaces at the base of the kiln.

Fig. 36.



Furnace à Alandier.

The porcelain kilns of Sèvres, and the fine faïence kilns of Staffordshire, have furnaces of this kind.

In the figure: —

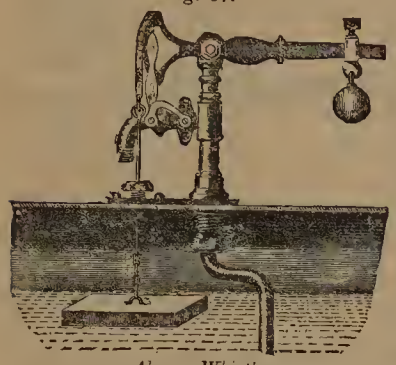
f, Is the fire.
b', Entrance of air.
b, Opening used only in starting the fire.
y, Chimney leading into the kiln.
g, Duct for flame below the kiln floor *k*.
x, *v*, Openings to examine contents of kiln.
u, Duct for cold air when required.

A-larm' Whis'tle. (*Steam.*) One constructed to be automatically sounded when water in the boiler sinks below a certain level.

In Fig. 37, the sinking of the float moves the counter-weighted lever and opens the valve, which permits steam to escape to the whistle.

Alarm whistles have also been constructed, to be sounded when the abnormal heat of a chamber, acting upon a thermostat, gives an alarm of fire. Tampering with a lock or a safe may, by electric connection, produce the same effect.

Fig. 37.



Alarm Whistle.

The alarm water-gage of *Ledent*, of Liége, is shown in "*Scientific American Supplement*," * 3899.

Al'bert-type. A printing process from films of bichromated gelatine exposed in a camera. See p. 57, "*Mech. Dict.*"

A modified Albert-type process, to produce colored pictures, was described in the New York "*World*," and the article reproduced in the "*Scientific American Supplement*," p. 2079.

The Albert process is described at length on p. 18 of the Report of Dr. C. A. Doremus, "*Vienna Exposition Reports*," vol. ii., section D.

Al'bo-car'bon Light. One in which the ordinary illuminating gas is enriched by the volatilization of so-called *albo-carbon*, the solid residuum of creosote, placed in the form of cylinders in a reservoir adjoining the burner, and heated thereby.

"*Engineering*" . . . . . xxvii., p. 157
"*Scientific American*" . . . . . xl., p. 201.

Al-bu'men-ized Pa'per. Paper prepared for photographic uses by dipping in a bath of white of egg, drying, and pressing.

Al'co-hol En'gine. In this connection the following items may be considered, in addition to the notices on pp. 58, 59, "*Mech. Dict.*"

Abbé d'Hauteville (1682) describes an engine, the action of which was produced by alternately evaporating and condensing, without allowing it to escape. — "*Reflexions sur quelques Machines à elever des Eaux*," p. 9. Paris, 1682.

See, also, English patent, No. 5,262 of 1825.

See, also, No. 9,118 of 1841. Tubes of alcohol or ether in a steam boiler, and connecting with a cylinder, the latter with a condenser. Vapor re-used.

Also, W. Ketland, Eng. Patent, No. 7,526 of 1838. Applies alcohol to condense steam that has worked an engine and uses the vapor generated to work another engine. Saves the condensed spirit vapor.

Al'co-hol'me-ter. The alcoholmeter of Dr. Siemens is an instrument by which a stream of alcohol and water mixed in any proportion is measured in such a manner that one train of counter wheels records the volume of the mixed liquor, while a second counter gives a true record of the amount of alcohol contained in it.

"The volume of liquid is passed through a revolving drum, divided into three compartments by radial divisions, and not dissimilar in appearance to an ordinary wet gas-meter; the revolutions of this drum produce a record of the total volume of passing liquid. The liquid, on its way to the measuring-drum, passes through a receiver containing a float of thin metal filled with proof-spirit, which float is partially supported by means of a carefully adjusted spring, and its position determines that of a lever, the angular position of which causes the alcohol counter to rotate more or less for every revolution of the measuring-drum. Thus, if water only passes through the apparatus, the lever in question stands at its lowest position, when the rotation motion of the drum will not be communicated to the alcohol counter, but in proportion as the lever ascends a greater proportion of the motion of the drum will be communicated to the alcohol counter, and this motion is rendered strictly proportionate to the alcohol contained in the liquid, allowance being made in the instrument for the change of volume due to chemical affinity between the two liquids." — *Nature.*

Ale Re-frig'er-a'tor. 1. An apparatus in which malt liquor is cooled either by surface exposure; in pipes exposed to a cool bath; or in a vessel traversed by pipes containing a refrigerating liquid. See Fig. 631, p. 264, "*Mech. Dict.*;" see, also, devices in CONDENSER, *Ibid.*

2. A case or box in which barreled beer is kept for dispensing. See Fig. 632, p. 265, "*Mech. Dict.*"

Al'eu-rom'e-ter. An instrument invented by M. Boland to measure the elasticity of the gluten of flour, when submitted to the temperature required to bake bread. Described, without cut, on p. 60, "*Mech. Dict.*"

The apparatus has a bath, *K*, of neat's-foot oil, beneath which is a lamp. The bath being heated to 318 F. (150 C.), the cover *E*, with the tube *F*, are lowered and then the aleurometer proper is put in. This is a brass tube, *D*, with a movable base-piece, *B*, and a cap, *A*; in which is a piston, *C*, the upper part of which has a scale graduated from 25 to 50. The piston being down, half the space beneath it is filled with a ball of gluten, prepared by kneading and working flour. The effect of the heat is to evaporate the water of the gluten (66 per cent.) and the gluten swells. Until it has doubled its volume the piston is not moved. Beyond this it registers from 25 to 50. Gluten which does not more than double in volume is not fit for bread, and the best has not exceeded 50.

Fig. 38.

Boland's Aleurometer.

"*Sc. American Supplement*" . . . . *p. 1871.
"*English Mechanic*" . . . . . *xxvi. 85.
"*Sc. American*" (by chloroform) . . xxxvi. 223; xxxvii. 120, 258.
"*Leffel's Milling and Mech. News*" . *vii. 83.
"*American Miller*" . . . . . *vii. 59.

Al'ge-rine'. (*Fabric.*) An all-wool French goods.

Al'i-dade. 1. The movable arm of a graduated instrument carrying sights, or a telescope.

2. A theodolite, or telemeter, provided with such an arm.

Two Viennese alidades shown in the Austrian Exhibition may be noticed: —

"Kraft & Son, of Vienna, had on exhibition an alidade, of which the pillar carrying the telescope was swung on a joint, so that both pillar and telescope could be lowered and made to lie flat and parallel with the rule. The object of this rather hazardous variation from the ordinary construction was to make the instrument more portable by reducing the size of its packing-box.

"Starke & Kammerer, instrument-makers for the Austrian Polytechnic Bureau, exhibited an alidade, with a telemeter attached to and parallel with the telescope, by which the distance of the instrument from the divided staff was determined by the angle subteuded by two fixed points on the staff. In other cases, the distance was obtained by observing the vertical distance on the staff subtended by a known

angle or two fixed wires in the diaphragm of the telescope." — Report of R. D. Cutts, "*Instruments of Precision*," Vienna Exposition Reports, vol. ii.; § H, p. 8.

Al'i-ment'a-ry Ap'pa-ra'tus. (*Surgical.*) Devices for feeding the helpless or refractory, such are: —

Nasal, esophageal, rectal. See Figs. 403–405, p. 101, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Masticator, Fig. 406, *Ibid.*; and Fig. 3087, p. 1407, "*Mech. Dict.*"

A-liz'a-rine. The coloring principle of madder. It is made artificially from anthracine, a white crystalline substance obtained from coal-tar, which contains about 0.63 per cent. of anthracine.

Paper by Johnson	"*Sc. American Sup.*," 2128.
Alizarine. *Rumpff*	"*Sc. American Sup.*," 620.
Alizarine Blue. *Prud'homme*	"*Sc. American Sup.*," 2080.
Alizarine, Printing with	"*Sc. American Sup.*," 619.
Alizarine	"*Sc. American*," xli. 232.

Al'li-ga'tor For'ceps. (*Surgical.*) Forceps with long jaws toothed throughout their length.

Such are Thompson's urethral forceps for lithotrity; Figs. 169–171, p. 45, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Farabeuf's and *Hamilton's* Ostcophors, Figs. 53 *b*, 53 *c*, p. 12, Part I., *Ibid.*

And numerous other instances.

Al'li-ga'tor Leath'er. The tanning of alligator skins was commenced about 1855, and now from 17,000 to 20,000 are tanned yearly, which are consumed by boot and shoe manufacturers in the United States, as well as exported to London and Hamburg.

Al-loy'. Tellurium has been proposed as a substitute for copper as an alloy for gold and silver in coinage. "*Engineer*," San Francisco.

The Japanese alloys are mostly used for ornamental castings, statues, musical instruments, and bells. The name given to an alloy generally corresponds to the color produced by the treatment which the objects have to undergo before they are finished; thus some of the alloys are named *green copper*, *violet copper*, *black copper*, etc. This color depends both upon the composition of the alloy and the chemicals used in coloring the metal. There are many different means used to produce one and the same color, and it so happens that almost every manufacturer uses particular compositions of his own; generally it is only the proportions that differ, but sometimes even the constituent elements are different, although the alloy is called by the same name.

Green copper (*Sei-Do*) is composed of copper and lead, or copper, lead, and tin.

Sentoku-do of copper, lead, and spelter — similar to the old Corinthian alloy — is said to have been first produced by a large conflagration which took place in China during the earlier part of the fifteenth century.

Black alloy called *U-do*, of copper, lead, and tin; the brass, of copper and spelter, sometimes with a slight addition of lead, as, for instance, in Yechiu, one of the chief places of production of ornamental castings inlaid with gold and silver; the purple alloy is composed of copper and lead.

Gin-shibu-ichi is generally composed of four parts of copper or alloy and six parts of silver.

Shaku-do, copper with a small percentage (two to five per cent.) of gold, which produces a beautiful dark blue color, and is mostly used for articles formed by hammering, or for *repoussé* work, generally inlaid with gold and silver, and producing designs somewhat similar to *Niello*.

Bronze for locomotive whistles: —

Copper	80
Tin	18
Antimony	2
	100

Bronze for ball valves and pieces to be brazed: —

Copper	87
Tin	12
Antimony	1
	100

For working models; easily wrought: —

Copper	4
Tin	1
Zinc	0.25

Phosphor-tin for journal boxes: —

Tin with from 2.5 to 5 per cent. of phosphorus.

Ravenue & Co., of Berlin, Ger., "*Sc. Am.*," xl. 118.

Professor Silliman's process of making articles of metallic alloys resonant consists in exposing them for a determinate time to a temperature just short (say within 10° Fah.) of their melting point. This is claimed to endow them with a musical quality. — "*Scientific American Supplement*," 182.

An alloy by Matthey, of London: —

Platinum	80.660
Iridium	19.079
Rhodium	.122
Iron	.098
Ruthenium	.046

Density at 32° Fah., 21.6139.

This is so malleable and ductile, that it may be drawn to a wire a few hundredths of a mm. in diameter.

Organ pipe metal: —

Tin and lead in equal parts, cast into sheets and smoothed with a *planer*; that is, with a flat block beaten by a hammer.

White alloy, by Beirman & Clodius, of Hanover: —

Copper	72.25
Manganese	16.25
Zinc	8.75
Iron	2.50

This alloy is malleable, does not change when immersed in water for forty days, takes the silver plating well, but is a little yellowish.

White alloy, by Le Marquand, of Paris. It is not liable to oxidation: —

Copper	750 parts.
Nickel	140
Oxide of cobalt	20
Tin	18
Zinc	72
	1,000

Alloy, for jewelry, having the appearance of red gold $\frac{750}{1000}$ fine. By Meiffren & Co., Marseilles: —

Copper	800
Platinum	25
Tungstic acid	10
Gold	170

The three former are melted together in a crucible, and then granulated in —

Water	1 cubic meter.
Slaked lime	500 grams.
Carb. potassa	500 grams.

The granulated metal is dried, remelted, and the gold added.

The flux consists of boric acid, nitrate of sodium, and chloride sodium in equal proportions.

Alloy for jewelry, in imitation of silver — siderraphthite — (unchangeable iron), by Meiffren & Co., Marseilles: —

Iron	35
Nickel	23
Tungsten	4
Aluminum	5
Copper	5

The first two are melted together and granulated in a bath of —

Water	1 cub. meter.
Slaked lime	1 kilo.
Carb. potassa	1 kilo.

The latter three ingredients are similarly treated. The flux is one part boric acid to one of nitrate of potassium. Sodium and charcoal are added in melting the last-mentioned batch. The separate batches of granulated metal are then melted together.

The following patents may be consulted: —

Aluminum bronze	223,900	*Webster*	Nov. 2, 1880
Manganese bronze	206,604	*Parsons*	July 30, 1878
Nickel-zinc	225,977	*Fleitmann*	Mar. 30, 1880
Journal-box metal	179,616	*Schoenberg*	July 4, 1876
Metal coating alloy	234,482	*Jones*	Nov. 16, 1880
Bell-metal alloy	169,648	*Macker*	Nov. 9, 1875
Mock silver	153,154	*Campbell*	July 21, 1874
Coin alloy	219,265	*Hubbell*	Sept. 2, 1879
Coin alloy	191,146	*Hubbell*	May 22, 1877
Coin alloy	209,265	*Hubbell*	Oct. 22, 1878
Coin alloy	219,097	*Hubbell*	Sept. 2, 1879
Plating alloy	194,365	*Page*	Aug. 21, 1877
Shot alloy	204,856	*Sparks*	June 11, 1878
Manganese alloy	178,490	*Ward*	June 6, 1876
Anti-incrustation alloy	169,810	*Holden*	Nov. 9, 1875
Aluminum alloy	220,149	*Howard*	Sept. 30, 1879
Coin alloy	211,630	*Hubbell*	Jan. 28, 1879
Coin alloy	211,909	*Hubbell*	Feb. 4, 1879
Manganese bronze	208,266	*Hale*	May 7, 1878
Journal-bearing alloy tin, copper, antimony	221,400	*Downs*	Nov. 11, 1879
Door-knob alloy	149,506	*Morand*	April 7, 1874

See also ANTI-FRICTION METAL.

Notices are to be found under the following heads: —

Aluminium bronze.	Ferro-silicium.
Anti-friction alloy.	Fusible metals.
Anti-incrustation alloy.	Gold alloy.
Bell metal.	Lubricant alloy.
Brass.	Manganese bronze.
Bronze.	Metallikon.
Bronze iron.	Melting point of alloys.
Chromeisen.	Phosphor bronze.
Chrysoid.	Phosphor tin.
Dysiot.	Sideraphthite.
Electro-silicon.	Silver alloy.
Ferro-manganese.	Solder.

Numerous recipes for alloys for solder, fusible plugs, white metal, type metal, jewelers' uses, and various mechanical purposes, are given under ALLOYS, pp. 61–68 of "*Mech. Dict.*" On p. 68 of that volume is a list of 77 alloys, which are considered in their alphabetical order in the volumes of "*Mech. Dict.*"

The following works treat on the subject: —

Guettier's "*Metallic Alloys.*" (Translated from the French.)
Scoffren's "*Useful Metals and their Alloys.*"
Collins's "*Useful Alloys.*"
Overman's "*Metallurgy.*"
Larkin's "*Practical Brass and Iron Founders' Guide.*"
Graham's "*Brass-founders' Manual.*"
Greenwood's "*Manual of Metallurgy.*"
Spretson's "*Practical Treatise on Casting and Founding.*"

Al'lu-mette'. A match or taper for lighting a lamp or candle.

Al-lu'vi-um. (*Mining.*) A deposit of loose gravel between the superficial covering of vegetable mould and subjacent rock.

Al'man-riv'et. (From *Allemand.*) A form of joint in German armor in which the plates were slotted to slide on rivets to give flexibility to the armor.

Al-pac'a. (*Fabric.*) 1. A taffeta woven goods made of alpaca wool.

2. A dress goods of cotton chain and long lustre wool weft.

3. Figured fancy weaving makes *fancy alpaca.*

Al-pa'ga. (*Fabric.*) A French dress goods made in a taffeta loom. It has a cotton warp and Lincoln wool weft.

Al'pine. (*Fabric.*) A French goods, made on a "serge 2 and 1" loom; silk warp and merino wool weft.

Alt-az'i-muth In'stru-ment. A theodolite with adjustments for altitude and azimuth.

Al'ter-na'ting Cur'rent Ma-chine'. (*Electricity.*) One in which the current traverses in opposite directions alternately, as in the Gramme machine used with the Jablochkoff light.

* "*Telegraphic Journal,*" vi. 491.

Al'ti-tude Meas'u-rer. Pickering's altitude instrument is designed for measuring the distances and heights of mountains. It consists of a common telescope, with a level attached, a scale of equal parts in the eye-piece, and with a mirror of plate-glass fastened to the object-glass, so that it can be set at any angle. Two images are seen, one through the glass, and the other by reflection from its surface, and any two objects may be made apparently to coincide by turning the mirror through the proper angle. Selecting as our object the mountain whose distance is to be measured, and as the other any convenient, well-defined point, the telescope is moved through a known distance, and the apparent change of position of the two images is measured by the scale. The altitude is then determined by leveling the telescope and reading the apparent elevation from the graduated scale, which is now turned round. By a second inclined level higher mountains may be measured.

Al'um Bat'te-ry. (*Electricity.*) Useful in operating open circuit. It consists of zinc and copper, or zinc and carbon, without porous cups, immersed in a concentrated solution of alum.

Sabine, "*Electric Telegraph,*" 1867, p. 228.
Niaudet, American Translation, New York, p. 78.

Al u-min'i-um. The metallic base of clay. A white, sonorous metal of increasing importance.

The history of the production of the chloride of aluminium from alumina, by Oerstedt, the segregation of a gray metallic powder, by Wöhler, in 1827, and the production of metallic globules of aluminium by the last named in 1845, are mentioned on p. 70 of "*Mech. Dict.*" The modification of the Wöhler method, by M. H. Deville, in his works at Javelle, near Paris, under the patronage of Napoleon III., about 1857, are also referred to. The Deville process of that time is described with more detail in *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" tome iv., article "*Aluminium*" (edition of 1877), but more recent improvements have rendered it unnecessary to redescribe it.

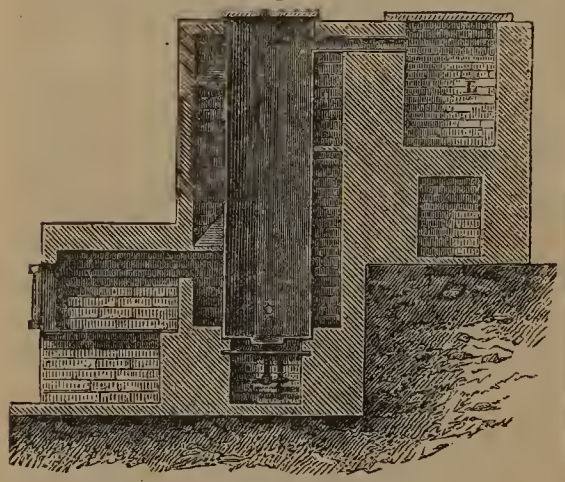
Very important in this connection are the successes of M. Deville in the production of sodium, so necessary in the aluminium process. Starting with the foothold acquired by MM. Mareska and Donny, who published a work on the extraction of sodium in 1852, "M. Deville has arrived at the production of sodium with a facility and in such abundance as but a short time ago would have been regarded as impossible." — *Laboulaye.* See the Dictionary above referred to for details of the sodium process.

"It is now certain that the fabrication of sodium is at least as easy as that of zinc, with which it has, for that matter, a very strong analogy." — *Dumas.*

Aluminium (by the later Deville process) is manufactured by decomposing the double chloride of

aluminium and sodium (cryolite), with the aid of metallic sodium. The sodium is obtained by heating to redness a mixture of 100 parts of calcined soda, 15 parts of chalk, and 45 parts of coal. The chloride of aluminium is prepared by passing chlorine gas over a moderately heated mixture of pure alumina (obtained either from alum or the mineral bauxite), common salt and coal tar. The idea of this mode of producing the chloride of aluminium is attributed to Thénard, and its first execution to Oerstedt, but it passed from a laboratory expedient to a practical use in the hands of M. Deville.

Fig. 39.



Deville's Chloride of Aluminium Apparatus.

The operation is conducted in an iron gas-retort, and the result of the interaction of the several substances present is the combination of the coal tar with the oxygen of the alumina, and the production of aluminium chloride, which unites with the chloride of sodium (common salt), forming a double salt, which volatilizes and is passed off into a separate chamber, where it condenses. From this method of obtaining the chloride, it is impossible to keep it free from chloride of iron, for which reason the Parisian aluminium is invariably adulterated therewith. From this double chloride of aluminium and sodium the metallic aluminium is obtained, either by passing it in the form of vapor over a heated surface of metallic sodium, in a simply constructed and connected system of iron cylinders appropriately heated, or the materials are at once mixed and heated.

The apparatus of M. Deville is shown in Fig. 36. The principal feature is a retort of fire-clay, like those used in gas-works, but set upright in the furnace. The retort has a capacity of 300 liters, and is heated by an envelope of flame, which follows a spiral course around it. It is pierced with three openings, two near the bottom, and two at and near the top. The opening *O*, near the bottom, is for a tuyere of porcelain, which reaches to the axis of the retort and introduces the chlorine gas into the charge. A second opening, opposite the former, is for cleaning out the debris of the exhausted charge.

Of the openings above, one on top is for the introduction of the charge, and the other at the side leads the volatile choride of aluminium into a condenser chamber, L, of masonry; or it may be made of boiler iron, and lined with glazed faïence tiles. The condensing chamber itself has a conduit for the escape of waste gaseous products.

The alumina employed is the result of the calcination of ammoniacal alum or sulphate of alumina. In place of adding to the alumina, first the pulverized coal, and then the oil, to render the mixture plastic, Deville employed simply coal tar, the refuse of the gas-works, which is very cheap and replaces the oil and coal. This mélange is calcined in earthen pots in a reverberatory, heated from the waste heat of the chloride furnace.

The mixture, being calcined, is charged into the retort, and the heat is gradually raised to a red. The current of chlorine gas is then introduced by the tuyere previously referred to, the production of gas being in stoneware pots containing peroxide of manganese and hydrochloric acid, heated in a sand-bath.

The chlorine does not attack the retort, but follows its axis in an upward direction, not extending laterally more than two decimeters, so that the sides of the retort are protected by a thickness of the charge not attacked by the gas. The chlorine is totally absorbed, and does not even show a trace in the condenser.

Rousseau has a substitute process, in the heating of a mélange of sea-salt, alumina, and coal, producing a liquid chloride which condenses continuously.

The employment of Greenland cryolite, which is a double fluoride of aluminium and sodium, is attributed to Rose, of Berlin. The cryolite is heated with an excess of sodium, when metallic aluminium and fluoride of sodium are produced, and the latter compound gotten rid of by treatment of the mass with caustic lime.

Of late, the metal has been manufactured from the mineral *bauxite*, especially at the factory in Salindres, near Alais (*Gard*), France. There the *bauxite* is heated with soda in a reverberatory furnace, the resulting aluminate of soda is extracted by means of water, and alumina precipitated by a stream of carbonic acid; this is then formed into balls, with salt and coal, and heated to a white heat in vertical retorts during the introduction of chlorine gas. The double chloride of sodium and aluminium, which distills over, is fused with the addition of 35 per cent. of sodium and 40 per cent. of cryolite as a flux, and the metal which settles at the bottom of the crucible is poured into molds. The cost of producing one kilog. of aluminium is stated to be 80 f., while the selling price is 100 f.

The employment of *bauxite* (*l'argile des Baux*) has served as a new point of departure in the aluminium industry, having more than any other increased the scale of production and the diminution of price of the metal. This may now be said, in round numbers, to cost but half as much as silver, and as it is but one quarter the weight of the latter, the metal for an object of a certain size in aluminium costs but one eighth of the same dimensions in silver.

Wilde's process has attained some notoriety.

Lead or sulphide of lead melted is poured on dried or burned alum; the result is crucibled with fluxes, the resulting metallic mass contains aluminium, which is separated, or the alloy can be used for some purposes.

Aluminium resists the action of the air, sulphurous gas from coal, weak acids, but is attacked by alkalies. It molds well. Its appearance resembles oxidized silver and makes it suitable for statuettes and vases; it is useful for culinary vessels, bottoms of sirup pans, and in many cases where its extreme lightness is an important consideration.

The difficult problem of soldering aluminium, seems to be resolved by the use of the alloys of that metal with zinc. See also ALUMINIUM SOLDER.

At present there are three aluminium works in France and one in England. Their total produc-

tion amounts to about $17,500 yearly, of which $10,000 are produced in France, and $7,500 in England.

The following references may be consulted : —

"*Scientific American.*"

Uses . . . . . xxiv. 136 : xxxvii. 153.
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In Germany . . . . xxvii. 279.
Bronze . . . . . xxvi. 364.
Alloys . . . . . xxix. 85, 186, 188.
In Telegraphy . . . xxv. 260 ; xxviii. 6 ; xxix. 186, 188.

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Manufacture . . . . xii. 127, 162.
Alloys . . . . . ix. 201 ; x. 182.
Cost : Coins . . . . xi. 120.
Bronze . . . . . viii. 240.

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Its Future . . . . . xxiii. 454.
The Metal . . . . . xxiii. 97.
Alloys . . . . . xxv. 228.

United States Patents.

Manufacture . . .	*Howard.*	220,148	Sept. 30, 1879.
Manufacture of Alloys	*Howard.*	220,149	Sept. 30, 1879.
English Patent . . .	*Thompson.*	2,101	Mar. 27, 1879.

Al'u-min'i-um Al-loy'. Aluminium now enters as an ingredient into various alloys ; that with copper is perhaps the most notable. See ALUMINIUM BRONZE.

Alloyed with 10 per cent. of copper, the alloy remains ductile.

Alloyed with small quantities of zinc, tin, gold, or silver, it remains ductile, but is rendered harder and more brilliant.

Alloyed with 3 per cent. of zinc, is a superior metal. — *Débray.*

Alloyed with 7 per cent. of tin, can be worked, does not take a fine polish, but is rendered non-homogeneous by fusion.

Does not alloy with lead.

Alloyed with 3 per cent. of silver, is of beautiful color.

With 50 per cent. of silver, is hard as bronze.

With 1 per cent. of gold, is hard, ductile, and greenish.

With 10 per cent. of gold, is crystalline.

With 5 per cent. of silver, can be worked like pure aluminium, but is harder, takes a fine polish. See also p. 71, "*Mech. Dict.*"

With 4 per cent. of silver, it is used by Sartorius, of Göttingen, for the beams of analytical balances.

One per cent. of aluminium with copper makes the latter more ductile, more fusible, enables it to fill the mold better, harder, more capable of resisting chemical re-agents.

Copper, with 2 per cent. of aluminium, is used by Christofle, in Paris, for works of art, and numerous "Articles de Paris."

True aluminium bronze has from 5 to 10 per cent. of aluminium. See ALUMINIUM BRONZE.

Silver, with 5 per cent. of aluminium, is hard as coin-silver, and is excellent for coinage.

Al'u-min'i-um Bat'te-ry. (*Electricity.*) One in which one or both of the elements consists of a plate of aluminium.

Al'u-min'i-um Bronze. An alloy credited to M. Débray, in which aluminium takes the place of tin or zinc, in combination with copper, to form a bronze.

This applicatiou of aluminium is at present the most important use of the metal. Even so small an addition as 1 per cent. of aluminium to copper considerably increases its ductility and fusibility, and imparts to it the property of completely filling the mold, making a dense casting free from air-bubbles. At the same time the copper becomes more resistant of chemical re-agents, increases in hardness without losing in malleability, and unites in itself the most valuable qualities of bronze and brass. The "alloy formed of copper 9 and aluminium 1, constitutes a new precious metal for industrial uses, which will find still more numerous applications when its price, still rather high (15 fr. the kilo), shall be reduced." — *Laboulaye.*

On account of its grain, it is especially suitable for parts subjected to friction, and slides of locomotives lined with aluminium bronze have outlasted more than twofold those of ordinary bronze. Besides its great tenacity, which much extends its applicability, it can, like iron, — and it is the only alloy which possesses that property, — be welded and hammered hot, at a distance sufficiently remote from its point of fusion.

The true aluminium bronzes, according to Rudolph Wagner, were first made by John Percy, in 1856. They are alloys containing 90 to 95 per cent. of copper, with 10 to 5 per cent. of aluminium. The direct mixture, by first fusion, of 10 parts of aluminium and 90 of copper, gives a brittle alloy, which, however, increases in strength and tenacity by several successive fusions. At each operation a little aluminium is lost. After the compound has been melted three or four times, however, the proportion of aluminium does not appear to change, and the alloy may be again remelted several times without alteration. These fusions are effected in crucibles. The aluminium bronze is homogeneous, and possesses sufficient expansion to fill the remotest parts of the mold. It affords sharp castings that can be worked more readily than steel. Aluminium bronze may be forged at a dull-red heat, and hammered until cooled off without presenting any flaws or cracks. Like copper, it is rendered milder and more ductile by being plunged into cold water when hot. The bronze polishes beautifully, and possesses great strength — according to Anderson's experiments, an average of 75,618½ lbs. per square inch. The resistance to compression is feeble. From the experimeuts of Col. Strange on the relative rigidity of brass, ordinary and aluminium bronze, it ap-

pears that the last named is four times as rigid as brass, and three times as rigid as ordinary bronze.

According to M. Morin, the director of the manufactory of Nanterre, very homogeneous alloys are obtained with copper and 5, 7½, and 10 per cent. of aluminium. The alloys with 5 and 10 per cent. of aluminium are both of a golden color, whilst that with 7½ per cent. has a greenish tint. A copper alloy with 2 per cent. of aluminium is said to be used in the Parisian ateliers, for works of art. It works well under the chisel and graver.

It is considered excellent for organ reeds, giving a better tone than brass or German silver. Also used for piano strings, and vibrating bars of music-boxes.

The uses of aluminium bronze in making various articles, such as cutlery, hardware, works of art, etc., and by M. Hulot, of the Postage Stamp Factory in Paris, are mentioned on pp. 70, 71, "*Mech. Dict.*;" and the series of Farmer's aluminium alloys is given on p. 71, *Ibid.*

The popularity of aluminium bronze is due to its beautiful golden color, which has enabled it to replace silver-gilt to a considerable extent. Its luster is very durable, which M. Débray explains by the great quantity of heat liberated when aluminium is combined with copper, showing that the alliance is very energetic and complete.

In England, kettles made of aluminium bronze are employed for making preserves and ices from acid fruits.

Morin & Co., of Nanterre, manufacture weavers' shuttles of bronze, which, of course, do not oxidize so readily as steel.

Cambrien recommends this alloy for type casting. Type made of it can be used fifty times as long as those from lead and antimony.

The alloy is largely used in the making of mathematical, optical, surgical, and scientific instruments.

"Aluminium bronze is used in France for making the large preserving pans used by wholesale confectioners, and is recommended as an alloy in type metal. Lange, in Glashütte (Saxony), employs an aluminium in the manufacture of watch-springs. The new springs have the advantage over the old in not being subject to rust, in not being magnetic, and in possessing greater hardness and elasticity. An alloy of 100 parts aluminium and 5 silver can be worked like pure aluminium, but is harder, and takes a beautiful polish. An alloy of 5 parts aluminium and 100 silver is almost as hard as ordinary silver, but has the advantage over it of containing no metal which is of a poisonous nature, or which can effect a discoloration of the silver."—"*Engineering and Mining Journal*," xxiii. 157.

Farmer's series of aluminium bronzes are given on p. 71, second column, "*Mech. Dict.*" They are hard, tenacious, laminable, and ductile.

See United States Patents:—

220,149	*Howard*	September 30, 1879.
223,900	*Webster*	November 2, 1880.

See also:—

"*Manufacturer and Builder*," viii. 240.
"*Eng. and Mining Journal*," xxvi. 364.

Al'u-min'i-um Gold. A substitute for gold.

Copper	90
Aluminium	10
	100

Has a color like 14-carat gold.

Copper	85
Aluminium	10
Gold	5
	100

Has a color like 18-carat gold, and is an excellent alloy for jewelry, and should be soldered with brass, silver, or gold solders. Avoid all potash for cleansing or as flux for soldering.

See, also, four of Farmer's formulas for *chrysoid* (Cu. Al. Ag.; Cu. Al. Zn.; Cu. Al. Fe.; Cu. Al. Ni.), giving alloys which in color and texture resemble gold. Page 71, "*Mech. Dict.*"

Al'u-min'i-um Gun-met'al. Two per cent. of aluminium added to the usual gun-metal.

Declared by Schulter to be equal to steel for guns. Good for statues, and bells also.

Al'u-min'i-um Sil'ver.

Silver	1
Aluminium	4
	5

Melted together. Valuable in instruments in which lightness is an object, such as sextants, octants, etc., which will weigh in this alloy but about one quarter as much as if made of silver. Aluminium pure is too soft for such purposes and works with difficulty.

Al'u-min'i-um Sol'der.

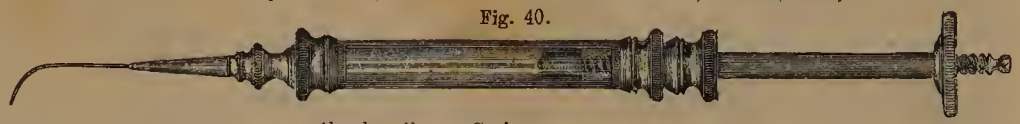
	Gold.	Silver.	Copper.	Brass.
Hard	88	6	6	–
Medium	54	28	18	–
Soft	14	57	15	14

Bottone recommends in preference to coat the surfaces to be soldered with a layer of copper in electro bath, and then use ordinary solder.

Al've-o-lar Ab'scess Syr'inge. A syringe for injecting abscesses in the alveolar ridge or processes. It has straight or curved canulas for more convenient access to the parts.

See "*Dental Cosmos*," November, 1876.

Fig. 40.



Alveolar Abscess Syringe.

Al've-o-lar For'ceps. (*Dentistry*) Forceps for gnawing away portions of the alveolar process, or for extraction of fragment of roots be-

Fig. 41.

Bayonet-shaped Alveolar Forceps.

neath the summit of the alveolar ridge. They have variously shaped beaks: bayonet, straight, curved.

A-mal'ga-ma'tion. (*Galvanic Battery.*) Coating the zinc plate with mercury so as to present to the liquid a surface of metal which shall be equally affected by the excitant, in order to prevent the establishing of local currents, which the impurities of the zinc would otherwise occasion.

Ganot, "*Physics*," N. Y., 1877, pp. 684, 692.

It is usually done by cleansing the zinc plate with dilute sulphuric acid, and then rubbing over the surface a small quantity of mercury.

A-mal'ga-ma'tor. The amalgamating machinery exhibited by the Republic of Chili at Philadelphia, 1876, was a facsimile of the apparatus in use at Autofagosta, on a scale of $\frac{1}{6}$th. It is under the system of Kröhnke. The series of machines and operations is as follows:—

The *washing and reduction* of the ore is accomplished by means of two vertical iron rollers, resting on an iron plate, and kept in motion, thereby producing the necessary friction. The rollers sit in an iron cup, into which the ores to be ground are received by means of a self-feeder. The water necessary is conducted to the cups by means of pipes, and is kept running continually. The reduced ore is carried with the water through gutters into the open, flat tanks below, and there allowed to settle; the water is then run off, and the ore carried to the drying shed.

In the *amalgamating* section are 12 large and 2 small revolving casks; 4 upright tanks, wherein the chemical solution is mixed: one washer; one centrifugal machine.

The powdered and dried ore is placed in the large casks, and mixed with sufficient cold water to saturate the whole thoroughly. The necessary quantity of the chemical solution from the tanks is then added, previously mixed with boiling salt water. After revolving the cask a sufficient length of time to transform the silver ore from a sulphite into a chloride, the quicksilver is added, and the whole subjected to the action of the amalgam. Thence the contents of the casks are run into the washer and there freed from the remaining impurities, acids, chemicals, etc., etc., leaving the pure silver and quicksilver. This then goes into the centrifugal machine, where the quicksilver is separated from the silver as much as this can be done by mechanical action. In case there should still be left some impurities, which may be easily detected by a dark color, the whole is returned to the two smaller casks, and there washed with boiling salt water, until its appearance shows the true silver color. It is then discharged and stamped into molds, to be ready for section three.

The *condensing and smelting* apparatus comprises four condensers and one smelting furnace.

The condenser consists of a cylindrical body closed hermetically at the upper end, while the lower end is open.

The cylinder or retort rests upon an iron plate, one third of which is below and two thirds is above the plate, this retort is surrounded by a furnace made of fire-brick. Below the retort is a mechanical apparatus, part of the machinery to be used to raise the silver into the retort. This apparatus is connected with a railway on which is placed a car fitted with an iron water-bucket, in which is an iron stand whereon the mold containing the silver and the residue of quicksilver not separated by the centrifugal machine is placed by the aid of a derrick. The mold, which is made of two equal pieces fitted and held together by means of iron pins, is then taken off, the car is run on the mechanical apparatus and the bucket filled with water, and the whole wound up, so that the silver column enters the open aperture in the retort and with the water-bucket closes this hermetically. The bucket being so much larger the retort stands from five to six inches in the water. After heating the silver column a proper length of time the quicksilver begins to evaporate, the vapors of which are so heavy that being brought into contact with the water they will soon condense and appear as metallic quicksilver at the bottom of the water-bucket. After all the quicksilver has been evaporated and condensed, the silver column is taken to the smelting furnace and there molded into bricks and bars.

Thirty-nine tons of silver ore are worked daily, and the loss is stated not to exceed 2 oz. of silver to 3 tons of ore, whatever the quality of the latter. The machinery cost $230,500.

Amalgamators involving electrical action are: —

Nos.	Inventor.	Nos.	Inventor.
34,881	*Davis.*	83,868	*McDougal.*
37,278	*Deetken.*	86,249	*Rae.*
61,866	*Rae.*	90,777	*Paul.*
62,776	*Rae.*	90,965	*Partz.*
66,529	*Swith.*	91,878	*Stevens.*
83,091	*Rae.*	96,931	*Paul & Wood.*

The following references may be consulted: —

Dickson	* "*Scientific American*,"	xli. 262.
Egleston	* "*Engineering*"	xxvii. 43, 128, 135.
Egleston	* "*Engineering*"	xxvii. 473, 491.
Egleston	* "*Engineering*"	xxvii. 190.
Wheeler, Varley,	*Horn, Patton,*	*Wheeler-Patton, Stevenson.*
Forster-Firmin	* "*Min. and Sc. Press*,"	xxxvi. 129, 137.
Forster-Firmin	* "*Scientific American*,"	xxxvii. 383.
Forster-Firmin	* "*Scientific American*,"	xxxix. 271.
Irwin	* "*Scientific American*,"	xxxv. 131.
Kröhnke	"*Iron Age*"	xviii., Nov. 16; 18.
Kustel & Hoffman	* "*Min. and Sc. Press*,"	xxxv. 145.
Mitchell	* "*Min. and Sc. Press*,"	xxxviii. 193.
Peck	* "*Scientific American*,"	xl. 275.
Porter-Firmin	* "*Eng. and Min. J.*,"	xxvi. 310.
Reynolds	* "*Min. and Sc. Press*,"	xxxviii. 136.
Russell	* "*Min. and Sc. Press*,"	xxxvii. 97.
Secor	* "*Min. and Sc. Press*,"	xxxiv. 372.
Stevenot	* "*Min. and Sc. Press*,"	xxxviii. 153.
	* "*Sc. Amer. Sup.*"	xxvii. 56.

A-mal'gam Car'rier. A scoop for carrying a small quantity of amalgam to fill a cavity in a

Fig. 42.

Amalgam Carrier and Burnisher.

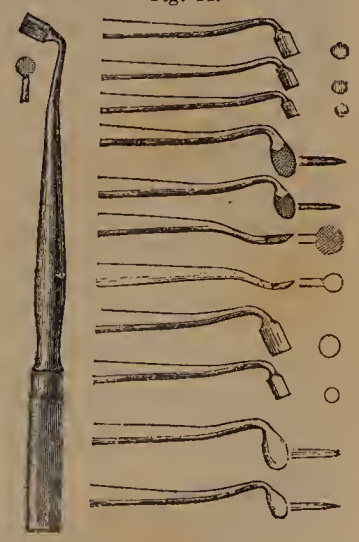
tooth. In the form shown, the back of the bowl serves as a burnisher.

Fig. 43.

Amalgam Manipulator.

A-mal'gam Ma-nip'u-la'tor. An instrument designed to facilitate the preparation of amalgam for fillings, having a cup at one end for taking up the desired amount of filings or powder, and a curved spatula at the other end for combining the mercury with the filings and packing it in the cavity.

Fig. 44.



Amalgam Pluggers.

A-mal'gam Plug'ger. A dentist's instrument

for packing and condensing amalgam or allied stopping material in the cavities of teeth. Used with a mallet.

Fig. 45.

Amalgam Retort.

A-mal'gam Re-tort'. An iron retort with a luted and keyed lid, with a hollow inside the latter for expansion.

Am'a-to'ri-i. (*Ceramics.*) Dishes in majolica with portraits of the ladies to whom they were presented. An Italian device.

Am'ber. A fossil resin, noted as being the first electric substance known. It is largely found on the shores of the Baltic, which was formerly the only source of supply.

The word electricity is derived from the Greek name of this substance, ἤλεκτρον. Amber is largely used as mouth-pieces for pipes, etc. In the London Exhibition of 1851 there were four of these mouth-pieces, valued collectively at £1,000.

The Baltic is the principal source of amber, as it was perhaps in the time of Nero, but it is also found in Roumania, the latter the product of a different tree, and assuming various colors, red, pink, brown, blue, green, and black. These colors are frequently found mixed in a single piece, and lumps also occur with silver-colored veins and gold specks. On account of this variety of colors, the Roumanian amber is highly esteemed, and the darker and more beautiful pieces are more costly than yellow amber, especially as they are more rare.

German amber is found in the sea or in alluvial earth; the Roumanian amber is only found in mountainous places and highlands, where it is sought and dug out by the peasants.

On Amber. *Reboux* . . . "*Scientific American Sup.*," 1847.
Sources of Amber . . . "*Scientific American Sup.*," 168.

Am'ber, Ar'ti-fi'cial. True amber is the fossil resin of a pine.

Artificial amber is principally colophony, a resin obtained by the decomposition of turpentine.

The detection is by means of heat or solution.

True amber melts at 545°–550° Fah.; the spurious at a much lower temperature.

True amber is slightly attacked by ether and alcohol; the spurious very readily.

Am'ber Bronze. A mode of coloring iron.

An artificial bronze surface upon iron, obtained by rubbing brass upon the smooth iron surface, and protecting with varnish.

U. S. Patent, 197,572, November 27, 1877.

Am'ber Ce-ment'. A solution of hard copal in pure ether, of the consistency of castor oil.—*Rust.*

The carefully-cleaned surfaces of fracture, coated with the solution, should be pressed together, and retained in contact by a band. A few days are required for complete hardening.

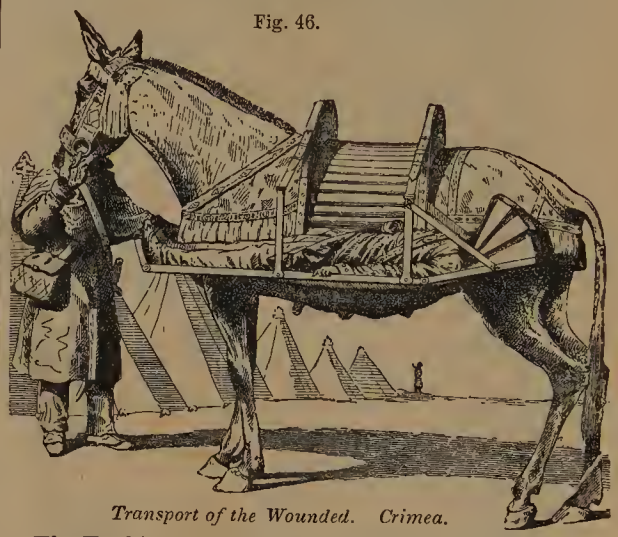
Small pieces of amber may be united to form a much larger one by moistening the surfaces to be united with caustic potash, and pressing them together.

Am'ber Var'nish. Yellow amber is bleached by being treated with a hot solution of salt; 1 lb. of the white product is dried, powdered, and melted over a fire in a clean iron pot. 1 lb. of fine nut-oil is then added, after which the whole is well stirred until thoroughly mixed. The pot is then removed from the fire, and when the heat is sufficiently moderated, 2 lbs. of the essence of turpentine is added to form a composition of the proper consistency for use.

"*Scientific American*," xxxix. 35.

Am'bu-lance. Fig. 46 shows one style of ambulance used in various semi-Asiatic armies.

Fig. 46.



Transport of the Wounded. Crimea.

The Turkish ambulance, on porter-back, is shown in a picture from the London "*Graphic*," reproduced in "*Scientific American*," *xxxvi., 151. See circular No. 6, Surgeon General's Office, U. S. *pp. 81–86.

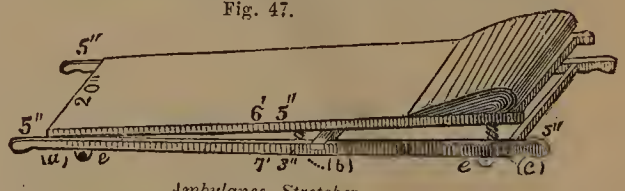
Am'bu-lance Cot. A cot adapted to be folded (or at least, as to the legs) to fit in an ambulance for transportation, or to stand on its legs when in field-hospital service.

See "*Art of War in Europe*," Official Report by General McClellan, War Department Series; * p. 80, where a French ambulance cot is shown.

Am'bu-lance Stretch'er. A litter to occupy a place in an ambulance wagon. Used to convey a soldier from the spot on which he falls to the ambulance depot, and then to form his bed in the wagon.

It is composed of two wooden frames, the lower one with handles, carrying an upper one, secured at one end with a hinge (*a*), and rising slightly towards the other, retained in the inclined position by India-rubber springs at *b* and *c*, which are encased with spiral steel cases. The bottom of the stretcher is formed of leather, and stuffed at the elevated end of the wooden frame to form a pillow. Rollers are attached to the under part of the lower frame at *e e*, to facilitate its being shoved into the ambulance wagon from the rear.

Fig. 47.



Ambulance Stretcher.

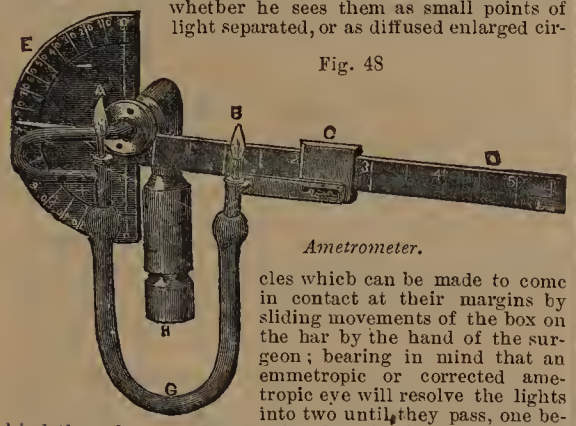
A'me-trom'e-ter. An instrument invented by Dr. Thomson for the diagnosis of refraction in the examination for defects in the human eye.

"It consists of a small fixed gas-jet *A*, a second one *B*, attached to a box *C*, which slides upon a bar *D*, the jest connected by a flexible rubber tube *G*; the end of the bar *F* forms a pointer, which, by elevating or depressing the other end of the bar, can be placed at any part of the graduated half-circle *E*, which is fixed firmly to the thimble *H*, by

which means the entire instrument can be attached to a common gas-burner, and the lights regulated by its stop-cock.

"The jets having been lighted and turned down into two small flames about 5 mm. in diameter, the patient, placed 5 meters away, is directed to observe the flames, and to say whether he sees them as small points of light separated, or as diffused enlarged cir-

Fig. 48



Ametrometer.

cles which can be made to come in contact at their margins by sliding movements of the box on the bar by the hand of the surgeon; bearing in mind that an emmetropic or corrected ametropic eye will resolve the lights into two until they pass, one behind the other, and become fused, whilst in ametropia the circles will seem to touch; whilst a distance, depending upon the degree of ametropia, remains between the small light points. To determine the kind of ametropia, the patient is directed to pass slowly in front of the eye under examination a slip of red glass in such a manner as to color half of each diffused circle, and if the red half seems to be on the same side with the red glass, myopia is recognized, and if on the other side, hypermetropia; this may be as well done by passing before the eye a card or paper in such manner as to exclude from view one half of each circle.

"To determine the degree of ametropia, the bar has been divided on one side into spaces of 2.5 cm. with a half space between, and on the other into English inch and half-inches, and it will be found that each space of 2.5 cm. will indicate an ametropia of one dioptric, metric system, and each inch $\frac{1}{40}$ of the old system. The cut represents the two flames as apart 2 dioptrics, and they would appear to a person having myopia or hypermetropia of 2 dioptrics or $\frac{1}{20}$ as two circles of light, with their margins in contact at one point, separating on the removal of light *B*, and overlapping when it is placed nearer to light *A*.

Fig. 49.

Amici Prism.

"For those who prefer the old system to the metric, it will be remembered that the old glasses are not based upon their exact powers of refraction, but are ground on *radii* of Paris inches, and that, owing to the index of refraction of the glass commonly used, they by a happy chance correspond in focal length almost exactly with the English inch; hence each inch of distance between the test-lights as determined by the use of the inch scale on the bar, will indicate an ametropia of very nearly $\frac{1}{40}$; and the higher degrees can be found instantly by dividing 40 by the number of inches between the lights when their margins seem to have come into contact." — "*Beck.*"

Am'i-an'thus. Earth flax: *i. e.*, ASBESTOS, which see.

A-mi'ci Prism. A device adopted by Amici, for throwing an oblique pencil of condensed light upon an object. See Fig. 49.

Am-mo'ni-a En'gine. The ammonia engine, which utilizes the expansion of liquefied ammonia, is described and represented on p. 90, "*Mech. Dict.*" and references made to Dr. Lamm, and to the dissertation of Dr. Barnard on the subject.

Gamjee's engine, U. S. Patent, No. 240,000, and dated April 19, 1881, uses the vapor or gas of ammonia expansively to the extent of more or less complete liquefaction, and then reconverts it from the liquid to the vaporous condition by means of heat, which restores it to its original tension. See THERMO-DYNAMIC ENGINE.

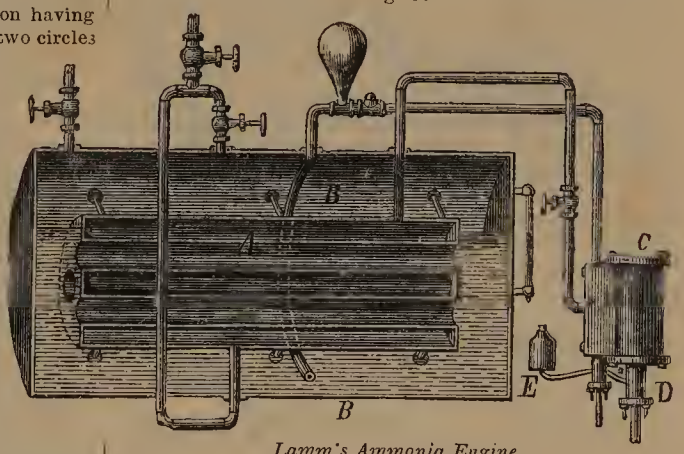
Seyforth's Ammonia Engine, "*Scientific American,*" * xxxix. 333.

M. Frot's machine is described in article "*Air Chaud,*" *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" edition of 1877.

The principle upon which the theoretical utility of ammonia, as a motor, is based, may be thus stated: As the gas is absorbed by water its latent heat becomes sensible, and the temperature of the solution consequently rises. This heat may again be used for the expansion of liquid ammonia into a gas, under great pressure — the pressure thus generated being converted into work behind the piston of an engine. The heat thus transformed into work cannot be recovered and utilized as heat, and, consequently, to maintain the efficiency of the combination, additional increments of heat must be supplied, from external sources, to be again converted into work, and so on.

In the apparatus of Dr. Emile Lamm (Fig. 50), the liquefied ammonia, which parted with its latent heat during condensation by pressure, is placed in the inner shell *A*, through which tubes traverse, the whole being inclosed in an outer shell, *B*. The fountain communicates with the valve chest of the cylinder *C*, in the same way as the steam induction pipe of a steam-engine connects the boiler and the

Fig. 50.



Lamm's Ammonia Engine.

cylinder. In the outer shell *B* is placed some of the water, or weak solution of ammonia that was left in the boiler of the still, of a suitable temperature to generate the required pressure at starting. This heat exists, then, in the liquefied ammonia as expansive force, and passes out with the gas to the cylinder, where, a portion having been converted into work, the remainder passes, with the exhaust gas, back to the weak solution in the shell *B*, where, the latter becoming instantly condensed, the heat is again rendered sensible and passes through the walls of the tubes, to generate expansive force, and so on, the total loss of heat for a given amount of work being the equivalent of the work performed, *plus* that which may have radiated from the shell during the performance of the work; while the loss of the material itself is only that due to whatever leakage has taken place.

An oil-packed stuffing-box is shown at *D*. An annular chamber surrounding the piston-rod is

kept supplied with oil from the chamber *E*, through a suitable pipe; this forms a practically impassable barrier to the escape of free ammonia. The oil becomes more or less saponified by the action of the ammonia; but this does not interfere with the usefulness of the packing, or the proper lubrication of the moving parts.

Lamm's United States Patents: —

No. 105,581	
121,527	December 5, 1871.
121,909	December 12, 1871.
124,485	March 12, 1872.

See English Patent, No. 2,768, of 1853. A hot-air engine, mixes vapor of ether with air.

Jean Frot's Ammonia Engine, No. 60,500, December 18, 1866. Specially designed for condensing, washing, and retaining for re-use the exhaust vapor.

See also English Patents: —

5,212 of 1825.
9,221 of 1842.

Lauback, U. S. Patent, May 28, 1872 . . . 127,250.

See also AIR AND GAS ENGINES FOR PROPELLING CARS. See also COMPRESSED-AIR ENGINE.

Bompas, Engl. Pat. No.	5,644	1828, Compressed air.
Stevens & Kershaw	1,092	1863, Compressed air.
S. Carson, U. S. Pat.	December 9,	1856.
N. H. Barbour	March 14,	1865, Carb. acid gas.

Am-mo'ni-a Me'ter. An instrument by Griffin, for testing liquid ammonia; one spindle, with 125°, which includes the strongest ammonia that can exist at the temperature of 62° F., and extends to all weak solutions: sp. gr. .875 to 1.000.

Every degree shows seventeen grains of dry ammonia in a decigallon of liquor. In "*Chemical Recreations*," p. 329, a table is given which shows every particular respecting solutions of ammonia; the strength in atoms, the percentage of ammonia, its weight per decigallon in grains, the comparative money value of different solutions per lb., etc.

Am-mo'ni-a Ore Pro'cess. The copper and silver salts, after calcination of the ore, are dissolved by means of ammonia and ammoniacal salts; this solution is then passed through a galvanic tank, formed by a suitable and economical arrangement of sheets of platinum and copper, by which means the whole of the silver is deposited in practically a pure state, whilst the copper passes on — still in ammoniacal solution — and is precipitated as oxide, by passing steam into the solution, with the simultaneous addition of a very small amount of caustic alkali. This not only precipitates the copper as oxide, but drives off the ammonia, which may be collected for re-use. The special advantages claimed for the ammonia process are chiefly its economy and simplicity, and the purity of the products obtained.

Am-mo'ni-a So'da Pro'cess. A process of soda manufacture, the success of which is mainly due to the ingenuity and perseverance of M. E. Solvay, of Couillet, Belgium. See p. 2234, "*Mech. Dict.*"

The fundamental reaction in the manufacture — the decomposition of common salt in solution by bicarbonate of ammonium into insoluble bicarbonate of sodium and chloride of ammonium, and the regeneration of the ammonia by treatment with lime — as contrasted with the cycle of reactions involved in Leblanc's process, attracted the attention of technical chemists long since. As early as 1838, the method was patented in England by Dyar, Gray, Harrison, and Hemming.

The subject is fully and lucidly treated in the Report of Dr. Jenkins, "*Paris Exposition Reports*" (1878), vol. iv., pp. 44 *et seq.*

See also "*Scientific American Supplement*," *2707, 2719, *3969, *4112.

"*Scientific Amer.*," June 24, 1876; and vol. *xxxvi. 405.

Am-mo'ni-a Test Ap'pa-ra'tus. W. W. Goodwin's ammonia and sulphur test apparatus, for gas works.

"*American Gas-light Journal*," *July 3, 1876.

Am'o-ri'ni Vase. A vase to be presented as a love-token. For instance, one at the Paris Exposition, by Solon, in the style of Louis XVI., the body in celadon, and an upper zone in blue with cupids in white. The vase supported by cupids (amorini), molded in oxydized silver.

Am'pli-fi'er. (*Microscope.*) A plan for increasing the magnifying power by means of a double concave lens placed in the body tube of the microscope, between the object-glass and the eye-piece.

The *Tolles* amplifier is discussed in the "*American Journal of Microscopy*," February, 1878. The remarks are reproduced in part in "*Scientific American*," xxxviii., 152, 202.

The Rev. J. H. Wythe, M. D., describes two amplifiers used by himself, as follows: —

"Either of them is used in a sliding tube between the eye-piece and objective, and the proper position is found by trial. The first consists of a cylindrical lens, conical in shape, with the smaller end concave, toward the object-glass, and the larger end convex. This gives a large increase of magnifying power and excellent definition when used with the strongest eye-piece of Gundlach, or other makers. The second form is better still, and consists of a double concave lens, having a virtual focus of about 1½", at the end of a tube about 6" long, at the other end of which is the ordinary negative eye-piece. In both these forms the extent and flatness of the field is quite remarkable, as well as the amount of light, while the amplification is very great. With a periscopic eye-piece of Gundlach, or the No. 3 of the same maker, or with the strongest eye-piece of Crouch, my ⅛th objective defines the semi-lenses on the frustule of *Pleurosigma angulatum*, the markings on *S. gemma*, or *Grammatophora subtilissima*, with a power of 4,000 diameters."

See also "*Carpenter on Microscope*," 1875 ed.

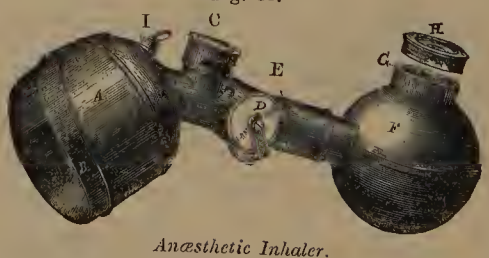
An'a-cos'ti-a. (*Fabric.*) A French goods made on a serge loom, and having a worsted warp and merino wool weft.

An'æs-thet'ic In-ha'ler. An instrument for the administration of ether, chloroform, nitrous oxide, etc. See pp. 92, 93, "*Mech. Dict.*"

In the illustration is a metallic inhaler consisting of —

A, A metallic hood containing
B, A flexible rubber hood covering both mouth and nose.
C, Exhaling valve.
D, Two-way stop-cock.
I, Packing through which passes a silken cord attached to a mouth-gag.
J, Contains the inhaling valve.
F, Hollow sphere containing sponge saturated with the anæsthetic liquid through the opening *G*.
H, Cover to close it when out of use.

Fig. 51.



Anæsthetic Inhaler.

Anæthesia, Early use of . "*Sc. American Sup.*" 1290.
Plaut . . . "*Sc. American*" . xxxv. 162.

A'nal Di-la'tor. (*Surgical.*) Instruments for distending the *sphincter ani* to permit examination of the mucous wall of the rectum, are shown in *Tiemann's* "*Armamentarium Chirurgicum*," as follows: —

Anal Dilator, Fig. 563, p. 119, Part III.
Thebaud's Sphincter Ani Dilator, Fig. 534, p. 119, Part III.

Called also RECTAL DILATOR.

A'nal Spec'u-lum. (*Surgical.*) *Speculum ani.* An instrument for exposing to view the interior of the rectum. The references are to *Tiemann's "Armamentarium Chirurgicum":* —

Gorget-formed Speculum, Fig. 549, p. 117, Part III.
Trivalve Trellis Anal Speculum, Fig. 547. *Ibid.*
Ashton's Fenestrated Anal Speculum, Fig. 546. *Ibid.*
Bodenhamer's Recto-colonic endoscope, Fig. 548. *Ibid.*
Bivalve Speculum Ani, Figs. 534, 559. *Ibid.*
Williams's Rectal Speculum, Fig. 623. *Ibid.*

See also ANAL DILATOR; HEMORRHOID INSTRUMENTS, etc.

A'nal Sup-port'er. (*Surgical.*) A pad of similar application to a truss, for supporting the part in cases of *prolapsus ani. Matthieu's, Tiemann's "Armamentarium Chirurgicum,"* Part IV., p. 134, Fig. 207; and p. 19, Fig. 46.

An'a-lyz'er. (*Optics.*) The upper one of the two Nichols' prisms in the polariscope; the lower one being the polarizer. See POLARISCOPE.

An-a-mor'pho-scope'. A device to illustrate certain optical effects.

The object has distorted figures, which become perfect on being looked at in the mirror.

Fig. 52.

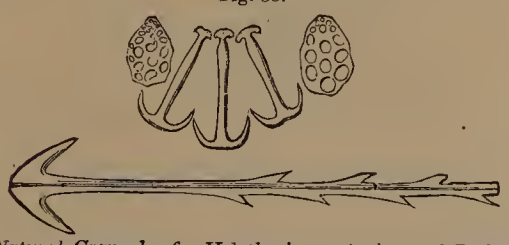
Anamorphoscope.

An'a-tom'ic-al Syr'inge. For injecting the arteries of the human body with an embalming fluid, or, in subjects for demonstrating anatomy, with a colored fluid which solidifies *in situ.*

An'chor. 1. The analogues in nature of the mariner's anchor are amusingly like the grapnel.

The upper one in Fig. 53 is from a relative of the sea-cucumber (*Leptosynapta Girardii*). It is covered with the symbol of the deep. The skin is filled with minute perforated oval plates, to each of which is attached by the shank a perfect little anchor. Doubtless the flukes of these anchors give it the means of keeping itself in place. The lower specimen is the *Pheronema*, which has its threads near the extremities marked by projecting notches, while at the very extremity it is actually anchor-shaped, as shown by a thread greatly magnified.

Fig. 53.

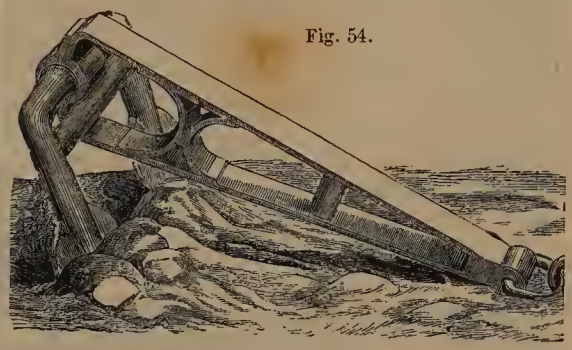


Natural Grapnels of a Holothurian. Anchor and Barbed Threads of a Pheronema.

Rosella, also, has a great outlay of mooring-threads, with frequently a line quadrate-barbed at its extremity. These lines have actually at the bottom a four-hooked grapnel.

Williams's "Reliance" anchor is without a stock, and is designed to be non-fouling and self-canting. It holds by both flukes at once, and has no stock

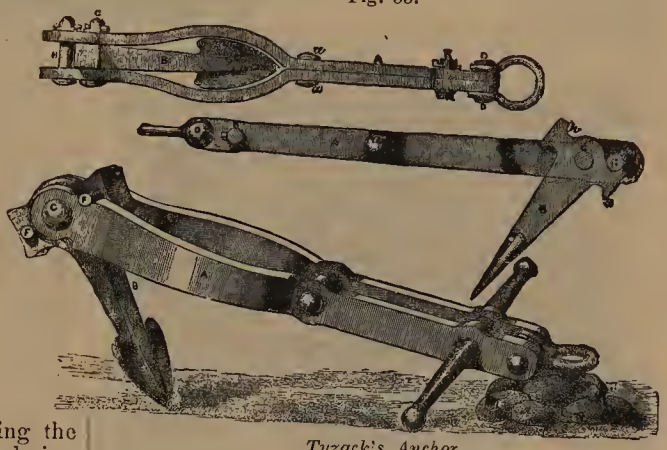
Fig. 54.



"Reliance" Anchor.

to foul the cable, like the Latham anchor, Fig. 190, p. 95, "*Mech. Dict.*" The pair of flukes hinged in the head are also like the Latham and the Morgan (Fig. 188, *Ibid.*). The Marshall (Fig. 189, *Ibid.*), has also hinged flukes, but they are independent.

Fig. 55.



Tyzack's Anchor.

In the celebrated Trotman anchor (Fig. 182), the arms are hinged to the shank.

Tyzack's anchor (Fig. 55, British) has a shank, *A*, made in two parallel parts secured together by pins, and a single arm with a fluke *B*, fitted with a *T*-head, which rests against a pin *H*. The advantages of this form are similar to those just recited: Relative lightness, absence of stock, ready assumption of holding position, ease of handling, etc.

This anchor was tested to destruction at the Lloyd's proving-house, Netherton, England, finally giving way at 250 per cent. overproof.

"*Engineer*," * xliii. 355.

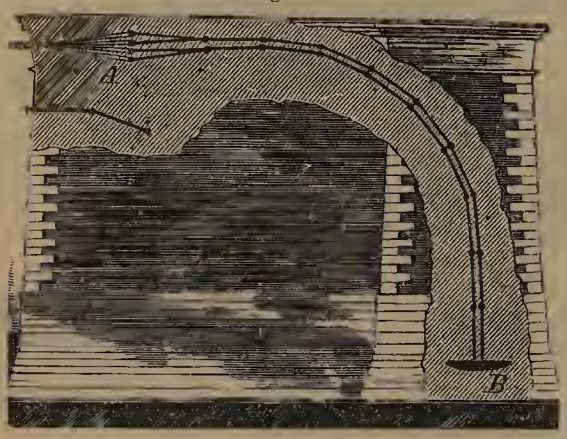
The Martin self-canting anchor is in much favor with the British admiralty, all the turret-ships being provided with it, has no stock, nor steadying arms. Admiral Inglefield's modification of the Martin resembles the latter in the special feature that the arms are on parallel lines, and so grip the ground simultaneously. It differs from it, however, in the very important characteristic, that instead of the arms being made of one forging, and working through the crown, they are formed of separate forgings, and are attached to the shank by a swivel pin. The advantages gained for the anchor are greater holding power and less liability to foul.

The parts of, and apparatus concerned with, the anchor and cable: —

Anchor lift.	Arm.
Anchor shackle.	Bill.

Blade.
Bower.
Bull rope.
Buoy rope.
Cable shackle.
Capstan.
Cat.
Cat back.
Clutch.
Compressor.
Controller.
Crown.
Deck stopper.
Devil's claw.
Dog stopper.
Fish.
Fluke.
Forelock.
Grapnel.
Kedge.
Kedging.
Kevel.
Link.
Messenger.
Mooring swivel.
Nippers.
Palm.
Passing nippers.
Pawl.
Pee.
Point.
Racking turns.
Ring.
Shackle.
Shank.
Slip stopper.
Square.
Stock.
Stopper.
Stream anchor.
Stud.
Swivel.
Swifter.
Throat.
Trend.
Warping.
Whelps.
Wing stopper.

Fig. 56.



Section of a Pier, East River Bridge, New York.

The following references may be consulted: —

Smith (Stockless), Br. . *"*Engineer*," xlvii. 219.
Spedden & Stafford . . *"*Scientific American*," xli. 7.
Swinburn (Portable), Br. *"*Engineer*," xliii. 427.
*"*Scientific American Sup.*," 1471
Tyzack, Br. . . . . *"*Engineer*," xliii. 355.
*"*Scientific American Sup.*," 1282

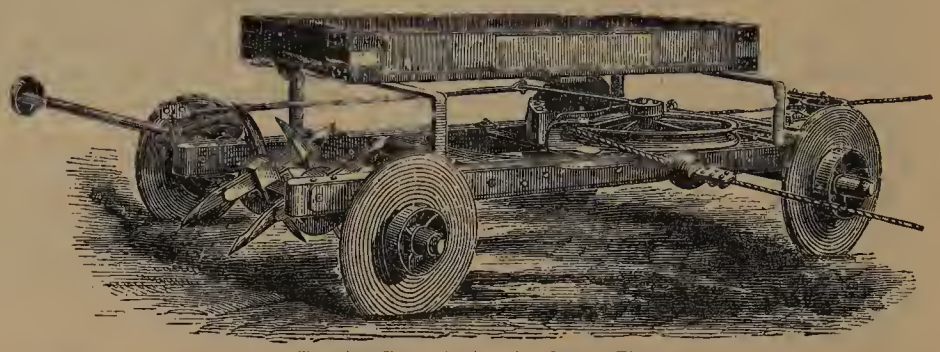
Fig. 57.

Anchor-plate, East River Bridge, N. Y.

2. The anchors for the suspension cables of the East River bridge are shown in Figs. 56 and 57. In the former the cable and anchor are shown in position, and in the latter figure an anchor-plate is shown separately.

Each anchor-plate weighs 23 tons, and is made with 16 radiated arms. Four of these anchors are required at each end of the bridge, two meeting on the central longitudinal line, and the others disposed one at each side. Each is imbedded in concrete in the third row of stone. Through apertures left in the centers of the plates the first set of bars for the chains is placed. Each chain has 10 sets of links and two sets lead from each plate. The section Fig. 56 exhibits the arrangement. To each pair of bars a strand of the cable is attached so that 19 strands in all will be fastened to the ends of two chains of bars leading from each anchor-plate. The strain on each of the four cables is estimated at 1,833 tons, or 7,332 tons on the collected four cables. Against this is the dead weight of the masonry structure, amounting to 44,000 tons. There is besides a pressure on the joints of the imbedded links which has been considered and provided for.

Fig. 58.



Traction Rope Anchor for Steam Plow.

"*Scientific American*" . . . . . *xxxiv. 15.
See also "*Scientific American Supplement*," *754, 755.

3. A movable pulley carriage to which the traction wire-rope of a steam plow passes at the headlands.

The frame carries a horizontal sheave and rests on thin disk wheels, which cut into the ground, and resist the side strain of the engine and implement. It is moved along the headland by the motion of the sheave or pulley, which is turned by the rope: the sheave is connected by gear to a drum, which winds up a rope stretched along the headland, and keeps the anchor opposite its work. The apparatus is provided with a steerage, which enables it to be worked along a crooked headland, and is managed by a boy, who also attends to shifting rope-porters. The box is to hold stones, intended as a counterpoise, to prevent the anchor from being pulled over when doing very heavy work.

The particular form shown is designed for the roundabout system. Two anchors are employed, occupying positions opposite to each other on the headlands, and proceeding at a right angle to the course of the plow. This form of anchor is automatically moved the regulated distance, equal to the width of cultivation of the implement at one passage, and this without the draw-rope reaching to a claw-anchor at the other end of the field.

See STEAM PLOW, "*Mech. Dict.*"

An'chored Net. (*Fishing.*) One secured by sunken anchors or stones, as with some seines. In contradistinction to *drifting* or *staked* nets.

An'chor Fish'-hook. An anchoring hook for fish-nets or lines. The line is bent around the grommet and lashed.

Fig. 59.

Anchor Fish-hook.

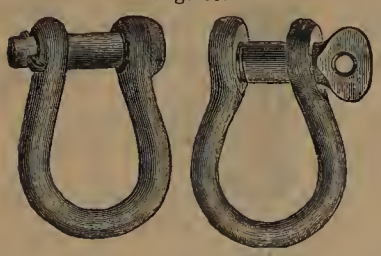
An'chor Lift. A device to lift the pile or pole wherewith a dredge or lighter is anchored. Such a pile is known — in Mississippi River parlance, at least — as a *grouser*, which see.

Canan's anchor-lift is a device on the dredge operated by hydraulic power to grip the anchoring pile during its upward movement, and slacken from it on the return motion, and so by a succession of movements to raise it from the mud or sandy bottom into which it had been driven.

"*Scientific American*," * xxxv. 70.

An'chor Shack'le. (*Nautical.*) The bow or clevis, with two eyes and a screw bolt, or bolt and key, for securing the cable to the ring of the anchor. Also used for coupling lengths of chain cable.

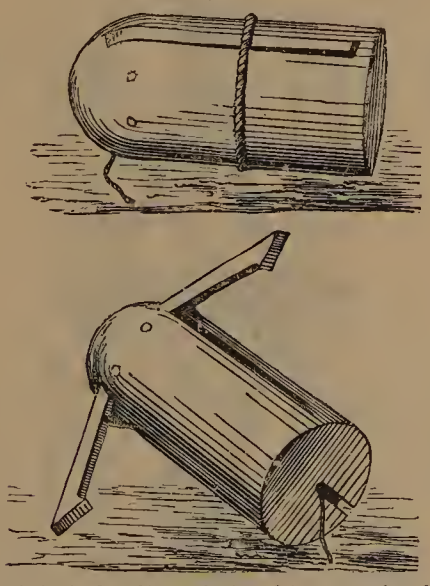
Fig. 60.



Anchor Shackles.

An'chor Shot. (*Life-saving Apparatus.*) A three-fluked anchor, with cord attached, fired from a gun on shore or aboard: in the first case, to afford communication with a stranded vessel; in the second case, to get a rope ashore, to enable boats to land through the surf. A *grapple-shot*; or *barbed shot*, which see.

Fig. 61.



Chandler's Anchor Shot. Before firing and after firing.

The invention of Capt. Ralph Chandler, U. S. Navy; the shot has hinged anchor flukes projecting from its sides, and folding back into slots, so as not to interfere with the entrance of the shot into the gun; but expanding when fired, to catch in the rigging. To the rear of the shot a chain or wire rope is attached, and carried to the front of the shot through another slot.

"*Ordnance Report*," 1878, Appendix P, p. 313, and Plate LII.
"*Army and Navy Journal*," April 27, 1878, p. 607.
"*Harper's Weekly*," June 15, 1878.

An'chy-lo'sis Ap'pa-ra'tus. (*Surgical.*) An apparatus for the gradual extension of contracted muscles. Used also for the breaking up of false anchylosis. Also as a safeguard against mal-position, allowing the joint to anchylose in the position of greatest usefulness in cases where a cure is impossible.

See *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.
Elbow-joint Apparatus, Fig. 53, p. 23.
Long Knee-joint Apparatus, Fig. 90, p. 48.
Short Knee-joint Apparatus, Figs. 91, 92, p. 49.
See also Fig. 202, p. 79, "*Mech. Dict.*"

An'der-son Bat'te-ry. (*Electricity.*) The ordinary zinc and carbon elements are employed; the zinc being placed in the porous cell and immersed in a solution of muriate of ammonium, and the carbon in oxalate of chromium and potassium, in combination with free bichromate of potassium and hydro-chloric acid.

"*Scientific American*," * xliii. 115.

A-ne'mi-us. A small chemical smelting furnace.

A-nem'o-graph. The vane for recording the direction of the wind, used in the observatories of France, consists of two connected strips of thin copper, about 2′ in length, attached to an axis at *A*, and having a counterpoise, which enables the vane with its axis to turn with great readiness.

Fig. 62.

Wind Vane of French Anemograph.

The axis has four copper disks attached. These are shown detached to the left of the cut, Fig. 62, and also in Fig. 63. Each disk is so cut that only $\frac{6}{16}$ths of its circumference has the full size; this portion only comes in contact with a metallic spring, of which there is one for each disk, and this wire connects with electric apparatus in the office of the observer. But two of the disks can be in electric connection at the same time.

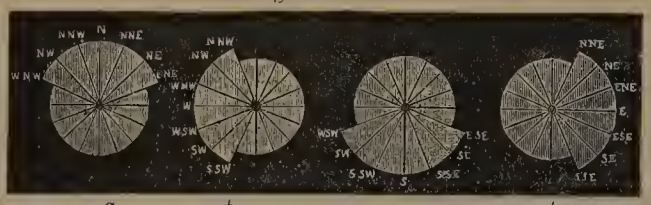
Take the left-hand disk (Fig. 63), for instance, Its surface has the 16 divisions, but only the 6, from E. N. E. to W. N. W., are on the extended portion of the perimeter, so as to touch the spring belonging to this disk. The other disks have each also the same proportionate parts of extended perimeters: the second disk from N. N. W. to S. S. W., and so on.

To illustrate, by tracing the action through a portion of a revolution, — at the compass point N. N. E. the North disk (*a*, Fig. 63) alone touches a wire, and but one pencil records upon the traveling

paper ribbon until N. N. W. is reached, when the West disk (*b*) closes the electric circuit, and two pencils record until W. N. W. is reached, when the circuit of the N. disk is broken, and the W. disk alone records. So on of the other portion of the circuit.

It will be noticed that at the cardinal points, N., W., S., E., and two points on each side (32 points

Fig. 63.



French Anemograph Disks on turning axis.

to the compass), only one telegraphic pencil is at work; at intermediate points two pencils record. Thus the direction of the air current is read within a point or two. Greater accuracy might be attained by multiplying the number of disks. The French observatories have four recording cylinders moved by clock-work. In the United States instruments one cylinder receives the four traces.

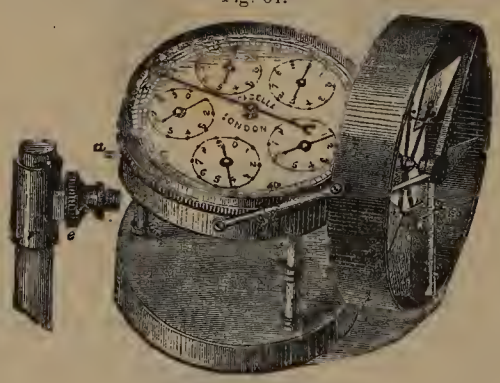
The anemograph of M. Redier, of Lyons, has a vane supported on a wheeled tripod revolving on a circular rail. The axis prolonged downward has a paper-carrying cylinder upon it; this is graduated vertically and horizontally, and a pencil applied to the paper is moved vertically by clock-work. The tracing gives wind direction and time.

An'e-mom'e-ter. An instrument for ascertaining the rate of the wind.

Casella's anemometer is a portable instrument, and is especially intended for measuring the velocity of currents of air passing through coal-mines, and the ventilating spaces of hospitals and other public buildings.

The indications are shown by a large dial and hand, and five smaller ones. The large dial is divided into 100 parts, and represents the number of

Fig. 64.



Casella's Anemometer.

feet up to 100 traversed by the current of air. The five smaller dials represent 1,000, and so on, multiplying successively by 10, to 10,000,000 = 1,893 miles. By means of the large dial, as low a motion as 50 feet per minute may be measured. By means of the catch, *a*, the work is put out of gear. A handle and universal joint, *e*, allow the apparatus to be lifted to a higher level, or thrust into an aperture.

See the following papers by J. W. Osborne, "*Proceedings of the American Association for the Advancement of Science*": —

"Construction of a Sensitive Wind-vane," * St. Louis Meeting, Aug., 1878.
"Wind-vane Rotations," * Nashville Meeting, Aug., 1877.

See also —

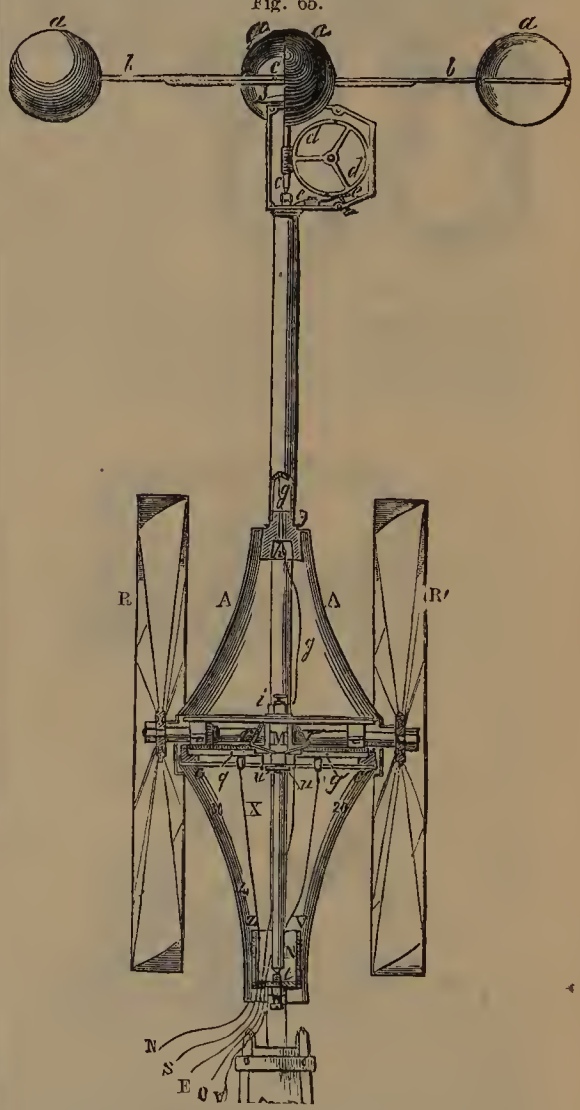
Anemometer, Electric. *Hardy* . . "*Teleg. Jour.*," iv. 134.
Anemometer . . . . *Long* . . "*Sc. Am. Sup.*," 1746.
Anemograph . . . . *French* . . "*Sc. Am. Sup.*," 112.
Anemometer . . . . *Negretti* . *"*Man. & B.*," x. 156.
Anemoscope, Br. . . *Vernon* . *"*Engineer*," xlviii. 268, 326.

An'e-mo-met'ro-graph. An instrument for recording the rate and direction of the wind.

The anemometrograph of *l'Ecole des Ponts et Chaussées* of France, is composed of two parts which may be regarded as distinct: the *anemometer* proper and the *register*.

The anemometer is on the principle of that invented forty years since by Dr. Robinson, of the Armagh Observatory, Ireland. It is composed of a hollow vertical shaft, of which the lower portion is secured on a mast of any convenient height. The upper end carries four radial horizontal spokes, *b*, at angles of 90°, each terminated

Fig. 65.



Anemometrograph of the Ponts et Chaussées, France.
(Elevation.)

by a light hemispherical metallic cup *a*, so disposed that the concavity of each is presented towards the convexity of the next one.

When this windwheel — as it may be called — is

exposed to a current of air, the wind strikes in the hollow of that cup, the concavity of which is favorably presented, but glides from the convexity of the others. Thus the windwheel assumes a rotary motion on its axis. It was demonstrated by Dr. Robinson that the number of turns in a given time are proportioned to the rate — that is force — of the wind, and it has been found that the number 3 expresses the relation between the speed of the wiud and the spaee traversed by the wings. Thus an anemometer, of which the cirele described by the center of the wings is equal to 1.67 meter, will give for each turn of the wings an indication of 5.01 m. as the distance traversed by the wind.

Below the windwhcel is a counter, which, by means of an electric wire (*V* in Fig. 65), transmits to the register (Fig. 67), the indications of speed.

Farther beneath, on a horizontal arbor, are fixed two large wheels *R R′*, with inclined vanes, which are driven by the slightest current of air.

The spokes of the wind-cups *a a* are mounted on a small vertical axis, *c* (Fig. 65), the pointed foot of which reposes upon an agate plate in a socket. A worm-wheel on the axis rotates a wheel, *d*, which has 200 teeth, and which carries on its side face two metallic pins which successively touch in passing a spring, *e e*. A wire *g* connects this spring with a binding-post, *i*, to which it is secured.

The shaft which supports the windwheel and the counter is hollow to permit passage to the insulated wire *g*, and is united by a screw-joint to the portion beneath, in which the axis of the windwheels *R R′* is journaled. *J* is a cap to protect from rain and dust.

Fig. 66.

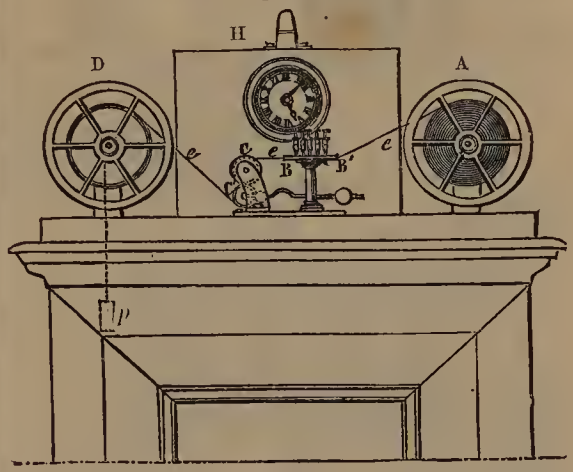
Anemometrograph. Ponts et Chaussées. (*Plan.*)

The horizontal arbor of the wheels *R R′* operates by means of the wheels and pinions *v v″* (Fig. 66), and a pinion meshing into a fixed crown wheel, *c c*, attached to the body *X Y Z*, which supports the whole instrument. Owing to this arrangement, when the wheels commence to turn under the influence of the wind, the pinion *p* turns also, but, in virtue of the reaction which it receives from the fixed teeth of the crown-wheel *c c*, it is displaced, and the wheels take a movement of translation around the vertical axis *M N* (Fig. 65), until the plane of their wings becomes parallel to the direction of the wind. The axis *M N* rests in a socket, *t*. A brass ring, *u*, secured by a screw, *u′*, holds it in the socket, and at the same time preserves the necessary connection between the moving and fixed portions of the instrument.

A cross-piece, *l l*, attached to the moving portion of the instrument, carries two springs, *x r*, which, drawn by the movement of translation, strike successively on four metallic sectors, separated one from the other, and inlaid in an insulated disk. From these four sectors, which correspond to the cardinal points, N., S., E., W., proceed four electric wires, *N S E O* (Fr.) as seen in Fig. 65. The binding post *i* communicates with another spring, which strikes in all positions upon a metallic circle, also imbedded in the insulated disk. The metallic contacts of the springs on the sectors, or on the circle, suffice to establish electric connection with the register, which remains to be described.

The registration is effected on a paper ribbon, *e e* (Fig. 67), which is unrolled from a bobbin, *A*, and which, having passed over an anvil, *B B′*, envel-

Fig. 67.

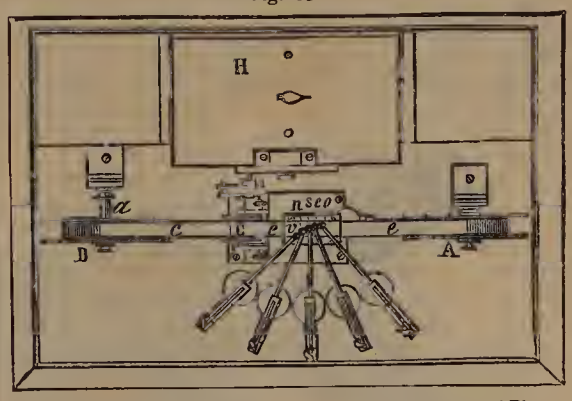


Anemometrographic Register. Ponts et Chaussées. (*Elevation.*)

ops in part the engine-turned cylinder *C′*, on its way, in turn to be again wound on the wooden drum of a pulley, *D*, which is turned by a weight, *p*, suspended by a silken cord from its axis.

The cylinder *C′* is governed by a clock movement inclosed in the box *H*, which gives the paper a uniform rate of motion. The inscription of the meteorological indications derived from the apparatus formerly described, takes place upon the paper ribbon by means of 5 steel points, *v*, *n*, *s*, *e*, *o*, put in

Fig. 68.



Anemometrographic Register. Ponts et Chaussées. (*Plan.*)

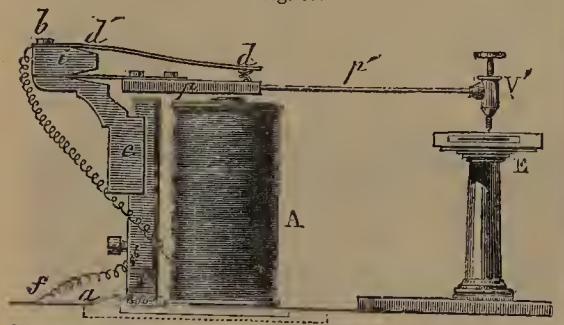
movement by the passage of an electric current in the electro-magnet corresponding to each point.

The 5 electro-magnets are identical with the pulsating armature electric bells; an improvement due to M. Hervé Mangon, now Director of the *Conservatoire des Arts et Métiers*.

The following is M. Hervé Mangon's arrangement of the electro-magnet in the registering apparatus of the Anemometrograph of *l'Ecole des Ponts et Chaussées* of France.

One of the poles of the battery communicates with the extremity *a* (Fig. 69), of the wire of the bobbin *A*. The other extremity of the wire of the bobbin is fixed by the screw *b* to the steel spring

Fig. 69.



Electro-magnet of the Anemometrographic Register. (Elevation.)

d' d. The other pole of the battery connects by the wire *f*, with a metallic piece, *c c*, which supports by a steel spring the soft iron armature *p*, the rod *p'*, and the tracing point *V'*. An insulator block, *i*, separates the spring *b d' d* from the piece *c*.

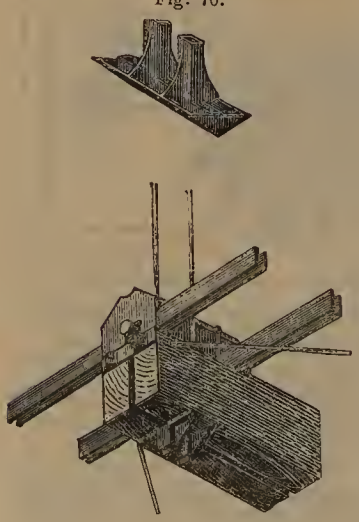
It will be seen that the electric current entering at *a*, follows the wire of the bobbin, arrives at *b d' d*, passes by the contact *d*, in the palette *p*, arrives at the piece *c*, and passes off by the wire *f*. As soon as a current is thus established the soft iron core of the electric coil attracts the palette *p;* the point *V'* descends, and strikes the paper placed beneath it on the anvil *E*. This descent destroys the contact between *d* and *p*, and breaks the circuit, consequently the palette *p*, obeying the spring which sustains it, rises to resume its former position and elevates the point *V'*. The contact is re-established in *d* and the preceding phenomena are repeated.

The point *V'* thus receives a rapid vertical vibration as long as the current is maintained.

It will thus be understood, referring to Fig. 65, that the point *v* will strike every time that the current shall be closed by the contact of the pin on the wheel *d d*, and the spring *e e;* that is to say, each time that the windwheel makes 100 turns.

As to the matter of the direction of the wind, it will be recalled that the striking springs are always in contact with one, or, at most, two of the four sectors answering to the winds of the cardinal points. It results from this that the electric current will pass by one, or at most by two, of the electro-magnets *N S E O*. The traces left then on the paper ribbon indicate the successive directions of the wind. If the two springs are in simultaneous contact with two opposite sectors, the two electro-magnets corresponding thereto will operate together, and will indicate that the direction of the wind is comprised between the two cardinal points to which the two sectors appertain.

Fig. 70.



Angle Blocks. (Upper and lower.)

The anemometograph of M. Secchi is shown in article *Météorographes*, vol. iv., ed. 1877, *Laboulaye's "Dictionnaire des Arts et Sciences,"* Figs. 14, 15.

An'e-roid. (Preferably, *a-ne'roid.*) Pillischer's (London), is self-registering, at certain intervals, by means of electro-magnets and a break-circuit clock. Shown at Vienna, 1873.

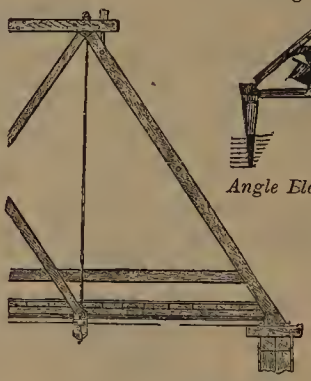
Aneroid, on the . *"*"*Engineering*," xxi. 223, 490.
""*Van Nostrand's Mag.*," xviii. 104, *201.

Cf. Plympton's "The Aneroid and how to use it."

An-gel'o-phone. An English name for a harmonium or parlor organ.

An'gle Block. 1. (*Bridge-building.*) Figs. 70, 71. A casting at the junction of the braces with the chord, in a bridge truss, and affording points of bearing for the suspension rods.

Fig. 71.



Portion of Bridge Truss.

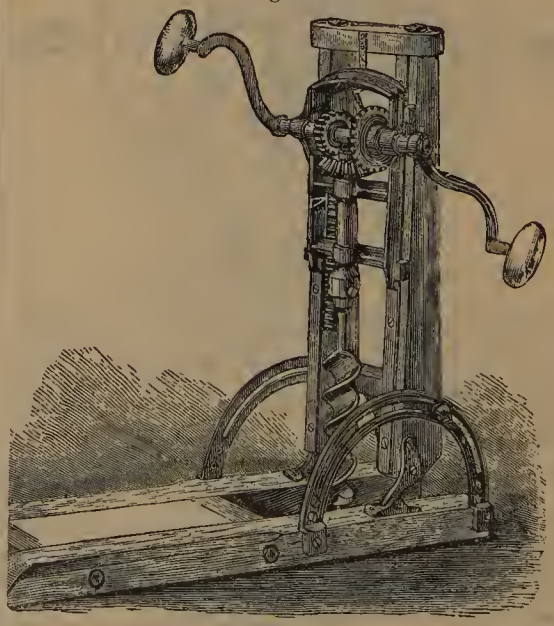
Fig. 72.

Angle Block.

2. (*Nautical.*) Fig. 72. A swivel dock-block used in changing the direction of a rope in hoisting or moving cargo, etc. It has usually an iron frame and sheave, and is anchored to a stake, or lashed to a ring-bolt.

An'gle Bor'ing Ma-chine'. A carpenter's machine for boring mortises. The semi-circular guides allow the standard to be set at any angle with the base which lies flatly upon the timber, in order to allow the holes to be bored at any desired angle.

Fig. 73.



Angle Boring Machine.

An'gle Brick. Bricks specially formed to enable other than square angles to be turned; either to make acute or obtuse angles, or to make the quoin ornamental. The angle bricks, shown in Fig. 74, are of the latter character, admitting of a mold-

ing in the corner, either cylindrical or with assizes of varying diameter.

An'gle Car-bor'ing Ma-chine'. A framing machine adapted for car shops, bridge work, etc. being capable of straight, angle, and end boring, saving the moving of the timber by being itself adjustable. (See Fig. 75.) Especially useful in boring holes in truck and body bolsters for truss-rods. The spindle has a horizontal movement of 24″. The head has a horizontal movement in planed slides in the frame, which permits it to be brought close up to the stuff when doing angle-work. The head is adjusted vertically by the hand-wheel, obviating the necessity for movement of the timber. The overhead belt is kept at a proper tension by a weighted pulley, which is hung in a slack loop of the belt.

Fig. 74.

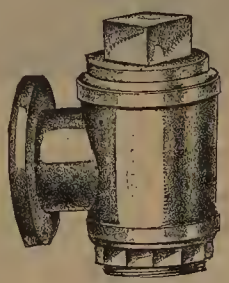
Angle Bricks.

Fig. 76.

Angle Check Valve.

An'gle Check Valve. A valve in a pipe meeting another at an angle.

Fig. 77.



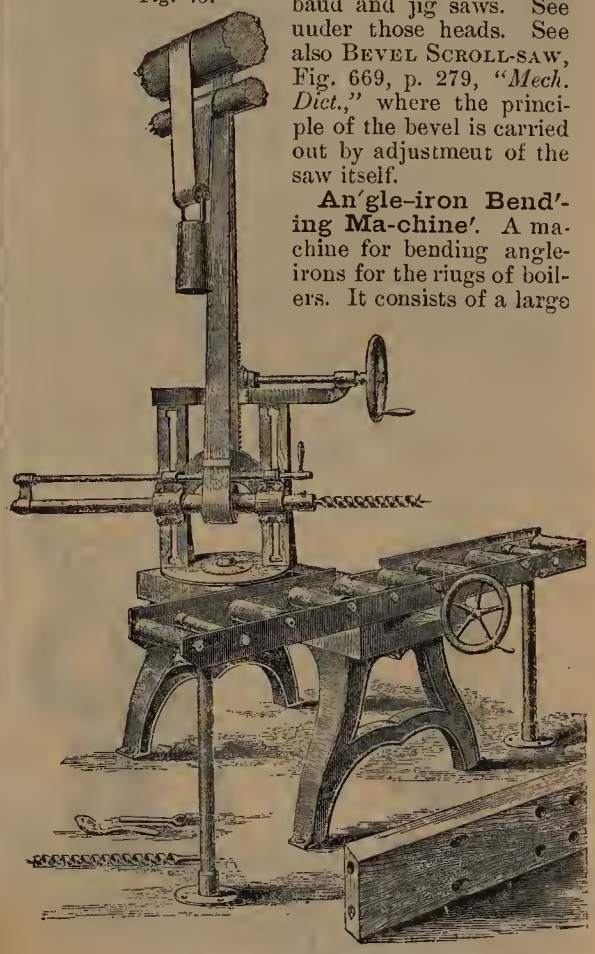
Angle Cock for Sugar-house use.

An'gle Cock. One occupying a position at a turn or bend of a pipe, as in the instance shown, Fig. 77, which is one adapted to sugar-house use.

An'gle-cut'ting Cir'cu-lar Saw. One adapted by adjustable bed and fences to rip, groove, or cross-cut, on any line oblique to the general working-line of the piece.

Angle cutting adjustments are found on other classes of saws, such as band and jig saws. See under those heads. See also Bevel Scroll-saw, Fig. 669, p. 279, "*Mech. Dict.*," where the principle of the bevel is carried out by adjustment of the saw itself.

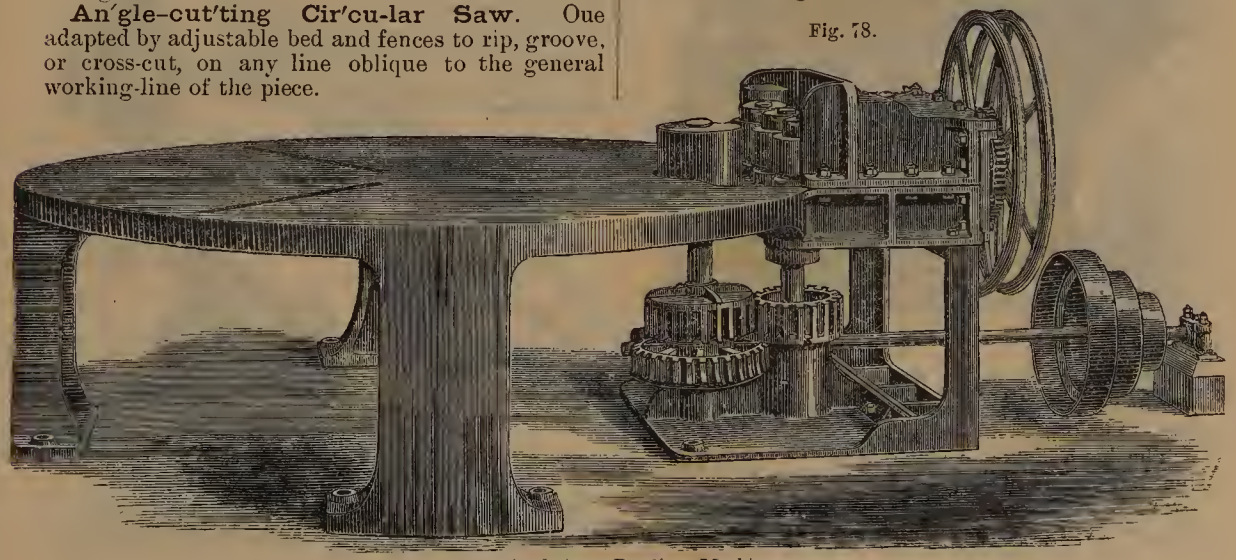
Fig. 75.



Angle Car-boring Machine.

An'gle-iron Bend'ing Ma-chine'. A machine for bending angle-irons for the rings of boilers. It consists of a large circular cast-iron table, to one side of which the bending mechanism is attached. There are one large and three small vertical rolls. The larger one revolves upon a fixed spindle, while the spindles of the others can be traversed by means of screws. The angle iron to be bent is gripped between the fixed and the middle traversing roll, and the two outer ones are then moved forward simultaneously to bend the bar to the curves required. One of the large hand-wheels is used for moving

Fig. 78.



Angle-iron Bending Machine.

the gripping roller, and the other for traversing the bending rolls, the screws employed for this being geared together. The two gripping rolls are driven by the gearing shown in the drawing, the moving roll being connected to the gearing by universal clutches, which allow a free motion to be given to the sliding bearings. The two bending rolls are free on the spindles, and are not driven. For carrying the angle-irons upon the table, rollers may be recessed into its face.

The machine illustrated in Fig. 78, was made for bending angle-irons for boilers 8′ in diameter.

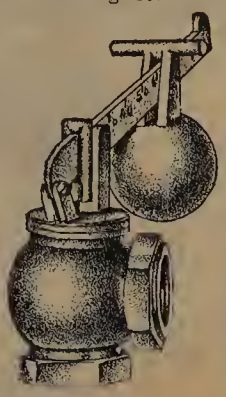
"*Engineering*," * xxiii. 421.

An'gle Meas'u-rer. Rutherford's glass scale, for the mensuration of angles of astronomical photographs, is about 10″ in diameter, divided to 10 minutes of arc, and adapted to a spectrometer similar to the one used by Mascart, and described in his paper on the measurement of wave lengths. The measurements are read by two microscopes, each magnifying 75 diameters. — "*Scientific American*," xxxv. 133.

Fig. 79.

Angle Pressure Valve.

Fig. 80.

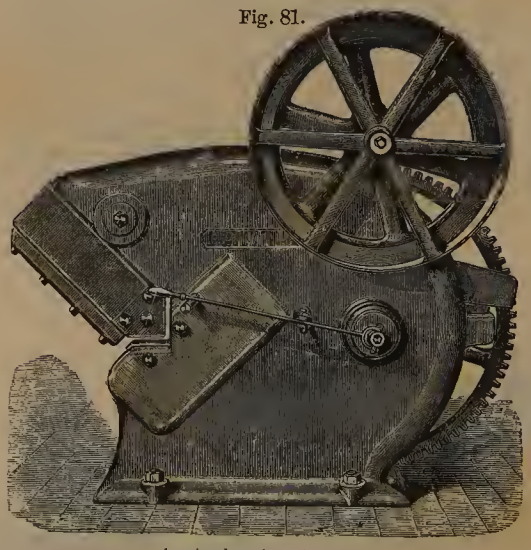


Angle Safety-valve.

An'gle Press'ure-valve. A weighted valve at the bend of a pipe. Fig. 79.

An'gle Safe'ty-valve. One placed at the bend or angle of a steam-pipe. Fig. 80.

Fig. 81.



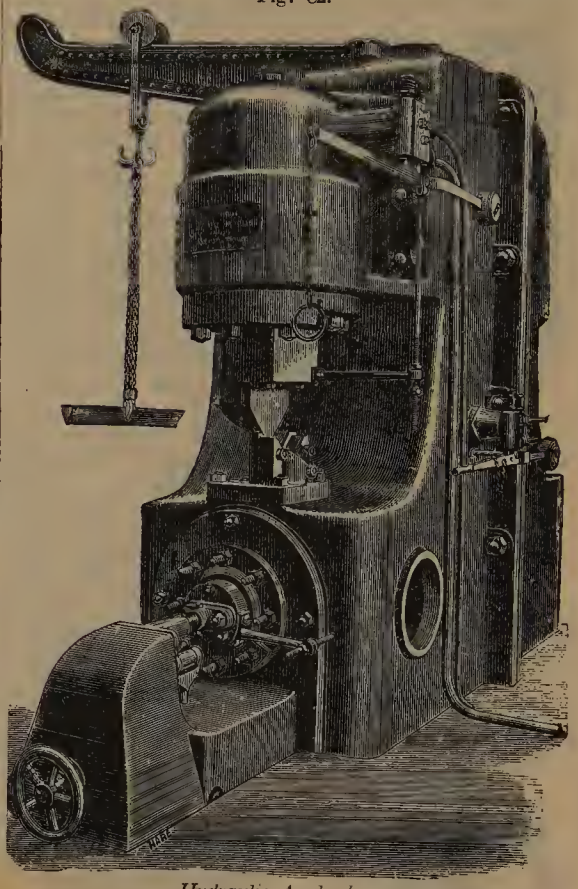
Angle-shearing Machine.

An'gle-shear'ing Ma-chine'. A shear adapted for cutting angle-iron while resting on trestles. Fig. 81.

The blades have no shear given to their edges; but by punching the angle off with a cut extending over all parts of the iron with uniform pressure, the piece cut off is not bent out of shape.

The shear is operated by a heavy wrought-iron lever within the housing. An independent stop-motion will permit the blades to rest open. The

Fig. 82.



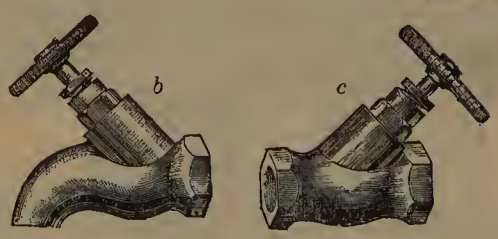
Hydraulic Angle-shear.

lower blade is in two pieces. The speed is 144 revolutions per minute, and the machine will shear 6″ × 6″ angles.

Fig. 82 represents a hydraulic angle-shearing machine, made by Tweddell for the French government dockyard at Toulon.

It is a quadruple angle-shearing and punching machine, and, with 1,500 lbs. pressure per square inch in the mains, will cut clean $6\frac{1}{2}'' \times 6\frac{1}{2}'' \times \frac{5}{8}''$ angle iron or any equal section, punching 1-inch holes in the same. The machine is really composed of four distinct tools, having independent connections to the main. In the shop the machine is partly sunk below the ground line.

Fig. 83.



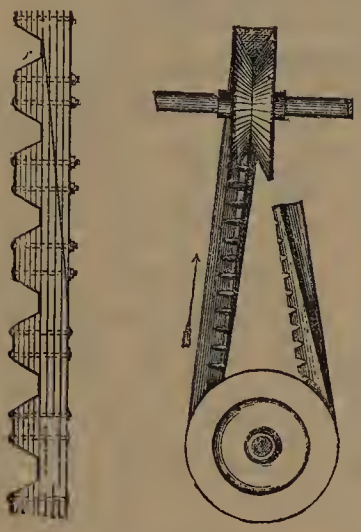
Angle Valves.

a. Angle valve in bend.
b. Full-way angle bib-valve.
c. Full-way angle stop-valve.

An'gle Valve. 1. One placed at a bend of a pipe or tube. In *a*, Fig. 83, it is operated by a

screw and hand-wheel, and has screw connection sockets.

Fig. 84.



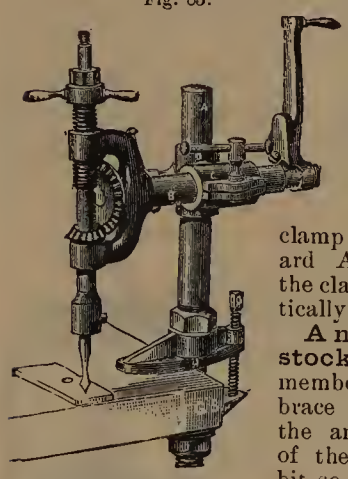
Angular Belting.

2. One having an angular presentation relatively to the line of direction of the pipe, as in *b*, *c*, Fig. 83.

An'gu-lar Belt'ing. A belting made of truncated wedging pyramids of leather of many plies, cemented and riveted together, the whole strongly riveted to a conveying strap of leather. (See Fig. 84.) The belt fits into the angular peripheral channel of the belt pulley, and has great adhesion.

An'gu-lar Bench Drill. A portable drill attachable to a bench, and capable of angular presentation relatively to the surface of the latter. Fig. 85.

Fig. 85.

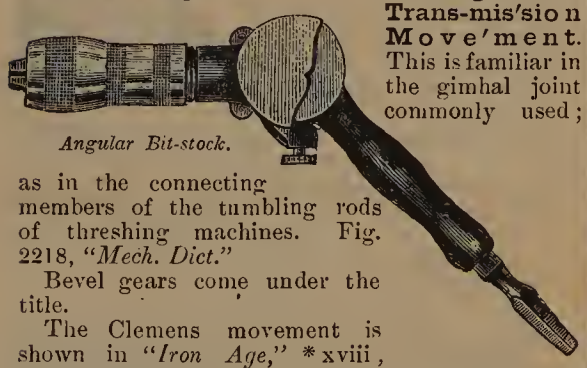


Angular Bench Drill.

The clamp *H* attaches it to the bench. The hollow shaft, *B*, may be slipped, or it may be rotated in the clamp *C* on the standard A, upon which the clamp itself is vertically adjustable.

An'gu-lar Bit'-stock. An extension member to the ordinary brace having a joint for the angular transmission of the movement to the bit so that the latter may reach an object to which the brace cannot be applied vertically. Fig. 86.

Fig. 86.



Angular Bit-stock.

An'gu-lar Trans-mis'sion Move'ment. This is familiar in the gimbal joint commonly used; as in the connecting members of the tumbling rods of threshing machines. Fig. 2218, "*Mech. Dict.*"

Bevel gears come under the title.

The Clemens movement is shown in "*Iron Age*," * xviii, September 28, p. 1.

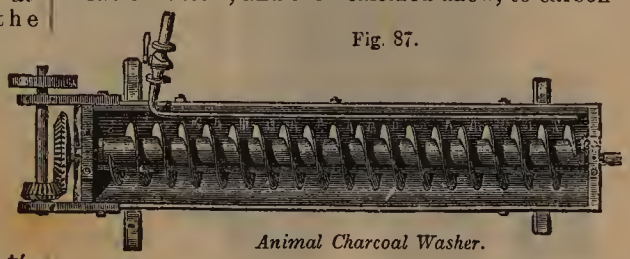
An'i-line Pen'cil. From Portuguese *anil*, derived from *nil*, the Sanskrit name of indigo, the *indicium* of Pliny.

French aniline pencils are made in grades, according to the hardness, very much like common lead pencils. The materials used are aniline, graphite, and kaolin, in different proportions. Made into a paste in cold water, the material is pressed through a screen that divides the mass into the slender sticks used in filling the pencils. When dry, the sticks are fitted to the wooden parts, and these are glued together in the usual way. They may be used in copying, marking in permanent color, and in reproducing writing or designs. In copying, a thin sheet of moistened paper is laid over the letter, design, or document, and the lines are traced with the pencils. The action of the water on the aniline gives a deep, fast tracing, resembling ink in color. On ordinary dry paper they give a well-defined mark that cannot be removed by India-rubber. When the paper is dampened with water, the markings assume the appearance of ink. Moistened sheets laid over the writing, under a slight pressure, will transfer good impressions, that do not blur, and that resemble the original in every respect.

An'i-mal Char'coal Re-viv'i-fi-er. The fabrication of bone-black, employed in sugar-houses as a decolorant and absorbent, consists in the carbonization of bones in a closed retort; the bones having previously been broken, and deprived, by boiling, of their fatty components. Green bones give a maximum of organic substance rather than those long exposed to the air, and give by calcination a more active decolorant.

The revivification of the charcoal consists in the processes employed to restore the decoloring property. For this purpose it is first washed to remove soluble matters, and then calcined anew, to carbonize the organic matters absorbed. This may be done twenty to twenty-five times, as the loss is from 4 to 5 per. cent. at each operation. This loss represents the diminution in weight, but the loss in value is greater, as the quality also deteriorates.

Fig. 87.



Animal Charcoal Washer.

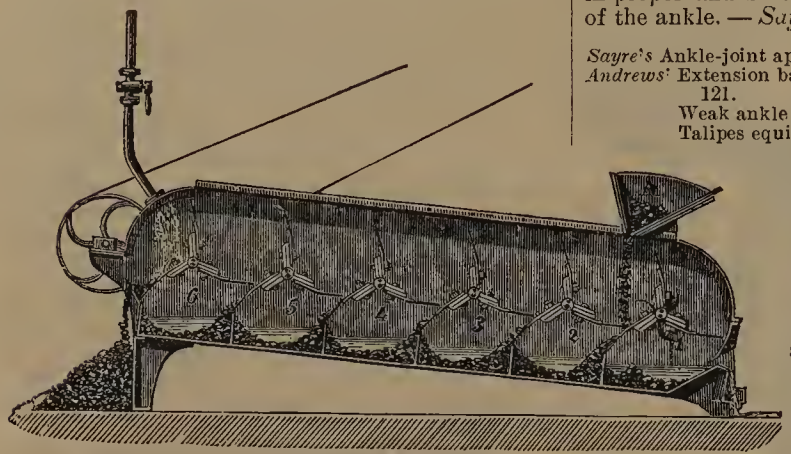
The washing may take place in water or in an alkaline liquor; but the preference is given to a weak solution of hydrochloric or acetic acid. Following the washing in the acidulated solution, which has, in the beet-sugar process, for its special object, the separation of the carbonate of lime absorbed, it is necessary to wash in clear water to remove the lime and traces of acid not neutralized. The washing takes place in the apparatus, Fig. 87, or Fig. 88; the former being customary in France, and the latter — the Klusemann washer — being used principally in Germany.

The action of the French machine is evident, the bone-black, fed in at one end, is passed to the other by means of the endless screw, being subjected to jets of water from the horizontal pipes throughout its whole course.

The German machine receives the charcoal from the hopper *A*, at the lower end of the machine. A stream of water is introduced at the other end, and the charcoal is advanced against the stream by successive liftings from one partition to another, until it is dumped at the upper end.

Furnaces, for recalcination of the bone-black, are shown in Figs. 786, 787, p. 328, "*Mech. Dict.*" The usual French charcoal revivifying furnace is that

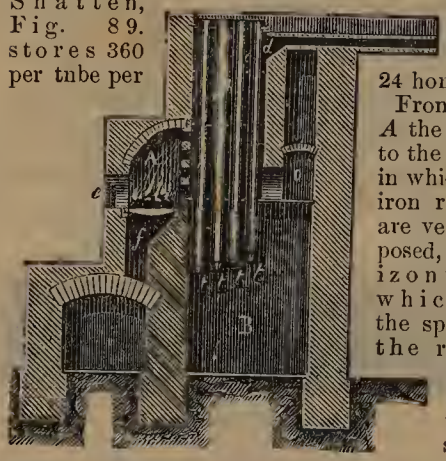
Fig. 88.



Klusemann's Animal Charcoal Washer.

of Blaise, mentioned in most books treating of the Beet-root industry (which see). A favorite German furnace is that of Shatten, shown in Fig. 89. This restores 360 kilograms per tube per 24 hours.

Fig. 89.



Animal Charcoal Furnace.

From the hearth *A* the gas passes to the furnace *B*, in which the cast-iron retort tubes are vertically disposed, having horizontal plates which separate the space around the retorts into four divisions. The upper and second quarters of the tubes are exposed to moderate and increasing heat respectively. In the third is the full heat of the fire, and the lower extends beneath the furnace bottom and allows the bone-black to cool before being discharged by the withdrawal of the register, which closes the lower end. The upper end of the retort is open, and the bone-black, somewhat dried upon the platform over the chimney, is shoveled into the tubes, the production being at the rate, say, of 11 pounds per 20 minutes, that quantity being retired below, and additional charge shoveled in above. The temperature is about 275° C., and the material augments in density in varying proportions, ranging from 77–80, up to 90–115.

It has been proposed by MM. Laurent and Thomas to revivify charcoal by superheated steam at a heat of 300° C., but it has not, according to M. C. Laboulaye, been reduced to practice.

An'kle Boot. (*Manége.*) A covering for the ankle of a horse, to protect it from injury when struck by the other feet; made of leather or heavy felt, with a small piece, called a shield, placed over the part to be protected.

An'kle Com-press'or. (*Surgical.*) An application of the nature of a bandage, consisting of a rubber sac around the joint, with tubes, by which hot or cold water can be passed through. — *Dr. Sayre.*

An'kle-joint Ap'pa-ra'tus. (*Surgical.*) An apparatus for maintaining the leg, foot, and ankle in proper and unvarying adjustment, for treatment of the ankle. — *Sayre.*

Sayre's Ankle-joint apparatus, Fig. 98, p. 52.
Andrews' Extension bandage for inflamed ankle, Fig. 186, p. 121.
Weak ankle support, Fig. 60, p. 27.
Talipes equinus apparatus, Fig. 62, p. 28.
Talipes varus apparatus, Fig. 63, p. 29.
Ball and socket club-foot shoe, Fig. 64, p. 30.
Talipes valgus apparatus, Fig. 65, p. 31.
Talipes calcaneus apparatus, Fig. 67, p. 31.
All in *Tiemann's "Armamentarium Chirurgicum,"* Part IV.

An'kle Shack'le. A manacle for the ankles; sometimes furnished with chain and ball.

An-neal'ing. (*Glass.*) A process the reverse of tempering. See TEMPERED GLASS.

(*Metals.*) In annealing cast-iron the malleable iron castings are put into iron boxes inclosed in pounded iron-stone or lime. The boxes are luted, rolled into a furnace or oven, heated for five days, and allowed to cool gradually in the furnace.

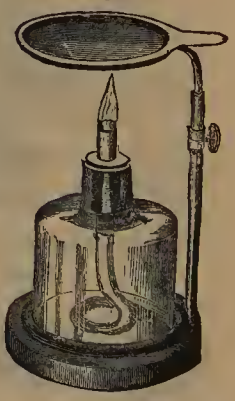
Slow cooling of bronze produces hardness.

See the following: —

Annealing Castings, Process for.
Robinson . . . . . * "*Iron Age*," xx., July 5, p. 7.
Annealing Furnaces, Construction of.
* "*Iron Age*," xxi., March 28, p. 7.
Annealing Furnaces.
Chess . . . . . * "*Iron Age*," xxi., Nov. 29, p. 5.
Ives . . . . . * "*Iron Age*," xx., Nov. 22, p. 5.
Annealing Oven, Iron . * "*Iron Age*," xxi., March 7, p. 7.
Annealing Oven, Glass.
Siemens . . . . . * "*Scientific American Sup.*," 4078.
Annealing by Electricity, Machine for.
Warrington . . . . * "*Scientific American Sup.*," 129.

An-neal'ing Lamp. An alcohol lamp and hot plate used by dentists for softening gold foil by heat, in order to render it adhesive when used in plugging teeth. The plate keeps it warm during the operation.

Fig. 90.



White's Annealing Lamp.

An'nu-lar Fur'nace. Fletcher's annular melting furnace (British) for crucible work is shown in "*Iron Age*," * xxii., November 21, p. 1; also in "*Engineering*," * xxvi., 140.

An'nu-lar Pis'ton En'gine. An engine with a ring-shaped piston, moving in the space between two concentric cylinders.

See ANNULAR CYLINDER ENGINE, pp. 115, 116, and Figs. 253–255, "*Mech. Dict.*" Also, Fig. 1742, p. 739, *Ibid.*; also, Figs. 4035, 4036, pp. 1830, 1831, *Ibid.*

In *Robertson's* steam-engine the piston reciprocates in the arc of a circle.

"*Scientific American Supplement*," * 1232.

Borsig, of Berlin, has introduced a compound 45 horse-power steam-engine with peculiar valve gear, and with annular pistons. It is shown and described in "*Iron Age*," * xxv., February 26, p. 1.

Young's annular cylinder marine engine (British), is shown in "*Engineer*," * xlii. 407, 412.

An'ode. (*Electricity.*) The positive pole or "upway," so named by Faraday.

The wire or plate connected to the copper or

other *negative* plate of the battery, and which leads the *positive* current to the object.

Wenzel's Nickel Anode, * "*Sc. American*," xxxix. 150.

An'te-ri-or Cur'va-ture Tib'i-a Ap'pa-ra'tus. (*Surgical.*) The instrument consists of two upright steel stems fastening below to a shoe, and above to a calf band. A leathern band passes forward over the arc of the curvature, and around the stems, so as to constantly afford a backward pressure upon the deformity of the tibia.

An'te-ri-or Splint. (*Surgical.*) A frame of stout wire suspended above a fractured limb, the latter being fastened to and suspended from the splint by rollers. The limb lies in a cradle of wire gauze.

See Smith's anterior splint and Byrd's wire gauze supporter, Figs. 102, 103 *a*, 103 *b*, pp. 50, 54, Part IV., *Tiemann's* "*Armamentarium Chirurgicum.*"

An'the-mi-on. An ornament in classic architectural decoration, derived from various floral forms, but especially the honeysuckle.

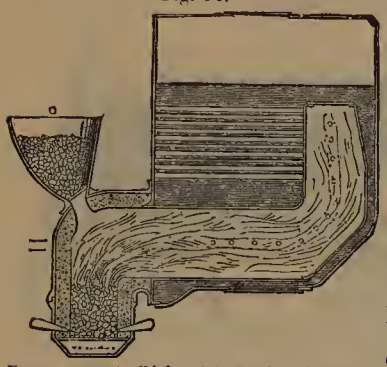
Wornum's "*Analysis of Ornament.*"

An'thra-cene. A product of coal tar.

Anthracene Manufacture, *Fenner*, * "*Sc. Am.*," xxxiv. 226. See U. S. Patent, *Perkin*, No. 127,426, June 1, 1872.

An'thra-cite Coke Fur'nace. The anthracite coke furnace of Penrose & Richards, of Swansea, Wales, has a gas generator, not immediately in contact with the boiler, composed of iron rings, keyed and luted and lined with fire-brick. The carbonic acid, formed at the interior part of the furnace, is reduced to carbonic oxide in passing through the incandescent fuel, and the requisite oxygen for its consumption is furnished by a pipe, shown in dotted lines, which has orifices through which the heated air under pressure reaches the interior of the furnace.

Fig. 91.



Penrose and Richards' Anthracite Coke Furnace.

c is the supply hopper.

An'thra-cite Dust Fur'nace. A furnace for burning the dust or slack of anthracite coal. This accumulates by millions of tons in the anthracite regions of Pennsylvania and Wales, and is a material addition to the cost and waste of mining operations in those regions. See WASTE COAL BURNING LOCOMOTIVE, for description of J. E. Wooten's locomotive.

An'ti-clink'er Grate. A stove grate placed below the fire-pot so as to leave an annular opening between the two through which the clinkers can be raked out from the fire.

An'ti-fric'tion-ate. A name given by the inventors to a combination of materials welded into a solid mass, for machinery bearings, or bearing linings. Patents July 6, and July 27, 1875.

An'ti-fric'tion Bear'ing. This subject has been considered under many heads: —

Anti-friction bearing.
Palier glissant.
Anti-friction box.
Anti-friction metals.
Anti-friction pulley.
Anti-friction step.
Anti-friction wheel, etc.

See pp. 118, 119, etc., "*Mech. Dict.*"

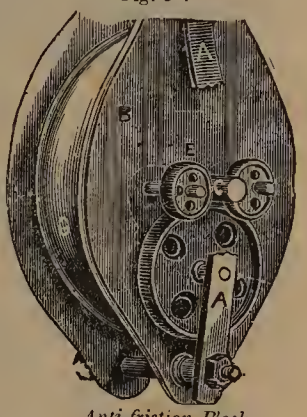
Avery's anti-friction has a circle of partially imbedded rollers in the journal. "*Scientific American*," * xl., 278; article "*Rouleaux*," * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877, where *Chauffour's* and *Brussaut's* (*) systems are described.

An'ti-fric'tion Block. One with roller bearings.

Such are seen in the "Climax" door-hanger, and in Fig. 263, p. 119, "*Mech. Dict.*"

In the illustration, Fig. 92, the pin *C* is keyed fast into the hub of the sheave *G*, and rests and turns on the roller bearings, one on each side of the block. The sheave *G* turns 5 times while *H* turns once. The smaller rollers, *E*, *F*, are to keep the axis *C* in place. The strap *A* is broken, to expose the parts.

Fig. 92.



Anti-friction Block.

An'ti-fric'tion Met'al. Belgian anti-friction metal is composed of —

Copper	20
Tin	4
Antimony	0.5
Lead	0.25

Mix all the other ingredients before adding the copper.

Doubleday's consists of cast-iron, copper, glass, antimony, tin, spelter, and lead. U. S. Patent, 178,841.

Coline. (*French.*) Asbestos and graphite in equal parts; mix, and reduce to a paste by addition of silicate of soda or potash. Pressed to shape in a hydraulic press, or pressed to a block and turned to shape when solid. When the bearing is shaped, steep in hot melted paraffine or wax; in solution of paraffine, benzole, or other mineral oil.

See U. S. Patents: —

189,684	*Behrens*	April 17, 1877.
162,065	*Harrington*	April 13, 1875.
157,509	*Guile*	December 8, 1874.
154,317	*Campbell*	August 25, 1874.
136,163	*Hunt*	February 25, 1873.
234,482	*Hunt*	November 16, 1880.
175,841	*Doubleday*	June 20, 1876
217,946	*Jackson*	July 29, 1879.
153,154	*Campbell.*	

An'ti-fric'tion Plow. One with rollers on sole, land side, or mold-board, to avoid friction of the passing soil. A doubtful expedient.

Such were shown at the Centennial by two Swedish exhibitors: Catherineholm's Foundry, and L. P. Eklundh.

It is, however, an old device. See *d*, *e*, *f*, Fig. 3823, p. 1745, "*Mech. Dict.*" Wilkie's plow of this class dates from 1825.

An'ti-in-crus'ta-tor. A material, process, or device to prevent the incrustation of steam boilers resulting from the adherence of a scale of salts of lime, etc. See list on p. 1177, "*Mech. Dict.*"

Vigier Process	"*Manufacturer and Builder*," x. 124.
Zinc	"*Scientific American*," xxxv. 58.
	"*Scientific American Supplement*," 518
Morehouse	"*Scientific American*," xlii. 374.
Holden's Alloy	"*Scientific American Supplement*, 468

An'ti-mo-ny Pho'to-graph. A process invented by F. Jones (Br.).

The process is based upon the reaction which takes place between sulphur and antimoniated hydrogen or stibine in the presence of light, by which sulphide of antimony results as the product of decomposition. "*British Journal of Photography*," 1876. Reproduced in "*Scientific American Supplement*," 352.

An-tique' Bronz'ing. A process designed to

give the *patina* or surface effect seen on ancient bronze, and due to exposure and the effect of time. Also known as ORUGO, which see.

The repeated applications on copper or brass of alternate washes of dilute acetic acid, and exposure to the fumes of ammonia, will give a very antique-looking green bronze, but a quick mode of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of one part of perchloride of iron in two parts of water. The tone assumed darkens with the length of immersion.

Or, the articles may be boiled in a strong solution of nitrate of copper.

Or, they may be immersed in a solution of two ounces nitrate of iron, and two ounces hyposulphite of soda in one pint of water. Washing, drying, and burnishing complete the process. See also BRONZE COLORING.

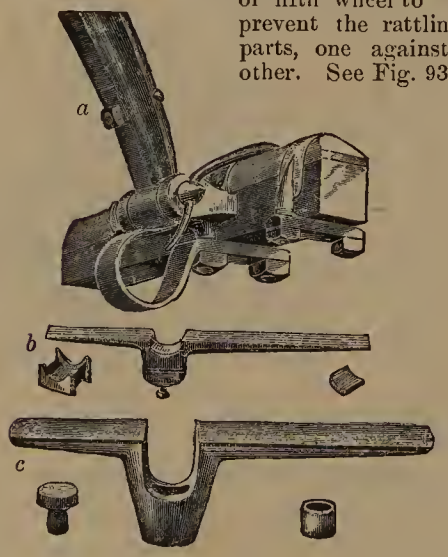
An'ti-ra'cer. A governor for propeller engines to prevent the *racing* of the screw when the ship pitches and throws the propeller out of the water.

Durham, Br. . "*Engineer*" . . . . . *1878.
"*Scientific American Supplement*" *2397.

See MARINE ENGINE GOVERNOR.

An'ti-rat'tler. An attachment to a carriage coupling or fifth wheel to prevent the rattling of parts, one against the other. See Fig. 93.

Fig. 93.



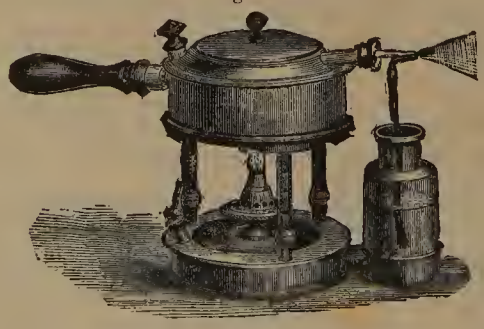
Anti-rattlers.

a. Represents Ladd's anti-rattler for shaft or pole couplings. A spring presses against the thimble to keep it from chattering on the bolt.

b. Is a fifth wheel anti-rattler. A caoutchouc pad rests in the bearing.

c. Wilcox's fifth wheel anti-rattler. A rubber sleeve is placed in the recess, and the rivet fastens down upon it.

Fig. 94.



Antiseptic Spray Apparatus.

An'ti-sep'tic Spray Ap'pa-ra'tus. (*Surgical.*) An atomizing apparatus for suffusing the atmosphere with vapor of an antiseptic solution in the vicinity of a wound while being dressed, or upon a cut surface during an operation. Mr. Lister is the principal authority in the matter, and his practice is most observed.

The apparatus is generally a steam atomizer, an alcohol lamp making a jet of steam which converts the antiseptic liquid into spray. The apparatus of *Hank*, *Weir*, *Heuel*, *Little*, and *Tiemann*, are shown in *Tiemann's "Armamentarium Chirurgicum,"* Part I., Figs. 408–412, pp. 119–123.

Figure 94 shows that of Dr. Weir, of New York. See "*New York Medical Journal*," December, 1877.

A somewhat similar apparatus is that of Dr. Louis Sass, of New York, described in "*Scientific American Supplement*," *1164.

An'trum Tre-phine'. A small crown saw used by dentists when it is desired to enter the antrum through a tooth socket.

Antrum Drill, *Pope's*, Fig. 50, p. 12, Part I., *Tiemann's "Armamentarium Chirurgicum."*

An'vil. A plate or cup inside the head of a cartridge to strengthen it. See CUP ANVIL; DISK ANVIL.

Fig. 95.

Antrum Trephine.

Anvil for Paper Cartridge Shells, *Saget*, *"*Sc. American*," xxxv. 53.

An'vil Cup'per. (*Cartridge.*) A machine for making the inside cup or case of the cartridge, which holds the fulminate; the stamp cuts them out, and by a die working inside the stamp, draws them to the required length.

Fig. 96.

Anvil and Vise Combined.

An'vil Vise. A compound tool in which the anvil forms one jaw of the vise.

Two forms are shown, in Figs. 96 and 97. One has a screw jaw at the square end of the anvil, and the other has a long jaw worked by treadle against the side of the anvil.

Fig. 97.

Combined Vise and Anvil.

Ap'a-re'jo. A pack-saddle, or the whole apparatus necessary for loading pack animals. It is one of a number of terms such as "sinch" (Spanish *cincho*, a girth) and "cabresto" (Sp. *cabestro*, a halter), which are working into our language from our Mexico-Spanish frontier.

Ap'er-ture Sight. (*Rifle.*) Another name for the *open bead sight.*

See BEAD SIGHT.

A'pex. (*Mining.*) The top or highest point of the mineral.

Aph'lo-gis'tic Lamp. A flameless lamp; one with platinum sponge and glass wick-holders. Also known as the *Dobereiner lamp*, and *Hydrogen lamp.*

A-phon'go-scope. See MEGASCOPE.

Ap'la-nat'ic Search'er. (*Optics.*) Another name for the amplifying lens. See AMPLIFIER. That of Dr. Royston Pigott is described in "*Microscopic Journal.*"

A-plat'is-seur. A name from the French. A grain-flattening mill. Used for the rough crushing of grain for feeding stock. It has a pair of rollers between which the grain is fed from a hopper.

See GRAIN-CRUSHER.

Ap'o-neu'ro-tome. (*Surgical.*) A blunt pointed curved knife, the blade on the concave edge, used in supra-pubic lithotomy in cutting the tendinous membranes, *aponeuroses.*

Fig. 155, p. 42, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ap-par'i-tor Au'ris. A species of ear-cornet in which the canal is elongated and overbridged so

Fig. 99.

Apple Corer and Slicer.

Fig. 98.

Apparitor Auris.

that sound entering the aperture *A* (Fig. 98), cannot diffuse, but is conducted within the tunnel through the meatus auditorius *B* to the tympanum.

The instrument is of silver, with flesh-colored enamel, is so shaped as to be worn within the concha, and is sold in pairs, one for each ear.

Ap'ple Co'rer and Sli'cer. An implement, Fig. 99, which acts by a simple downward thrust, removing a cylinder of apple containing the core, and cutting the apple into eight pieces.

Ap'ple Gra'ter. The Boomer & Boschert apple grater has an iron cylinder with planed grooves to receive the knives (8) which are adjustable by set screws above and below at each end, and held in their places by a heavy wrought iron band shrunk on at each end of the cylinder. The concaves consist of five iron levers with movable weights.

"*Scientific American,*" * xlii. 242.

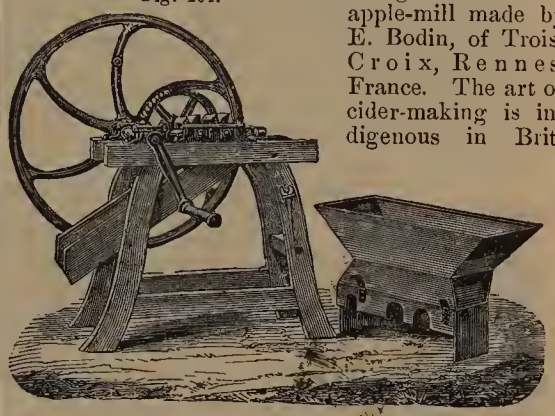
Ap'ple Grin'der. A mill for grinding apples previous to pressing the pomace.

Fig. 100.

Nut of the Apple Grinder.

Fig. 100 shows the galvanized cast iron nut and concave of the "Peekskill" apple grinder.

Fig. 101.



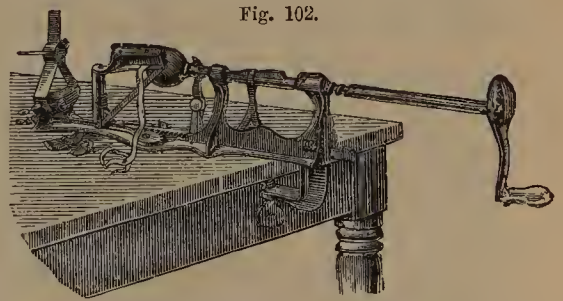
Bodin's Apple Grinder, Rennes, France.

Fig. 101 shows an apple-mill made by E. Bodin, of Trois-Croix, Rennes, France. The art of cider-making is indigenous in Brittany, and it is considered that the crushing-mill is superior to the grater, giving a pomace which affords a clearer juice, with less pulp, and consequently less tendency to ferment. The *nuts*, or toothed cylinders, have six teeth, and can be approached or parted by means of two screws.

The duty is from 175 to 200 gallons per hour, by the moderate work of two men.

Ap'ple Par'er. The "Missouri" combined apple parer, corer, and slicer, works by a horizontal motion, the circular movement of the shaft rotating the apple, and the endwise movement of the shaft giving the sweep to the knife; after which a simple thrust delivers the apple to the corer and quarterer, the quarters dropping to the table while the fork withdraws with the core. See Fig. 102.

Fig. 102.



Combined Parer, Corer, and Quarterer.

Ap'pli-ca'tor. (*Surgical.*) Uterine and urethral applicators, for introducing medicaments, caustic, sponge tents, etc.; pp. 21, 65, 73, 77, 82, 83, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ap-plique'. 1. (*Fine Art Metal Working.*) Ornaments produced by affixing portions to the surface of the object. The metal is previously rolled or stamped into figures, scrolls, braids, etc., and these are soldered on to the object to be ornamented. The result resembles *repoussé*, which is,

however, produced by indenting the metal from the interior.

2. In cloth work, also known as *opus consutum*, or cut cloth work, the patterns are cut out and then sewed on.

Fig. 103.

Apron.

A'pron. (*Hydraulic Engineering.*) A protecting surface of logs and brush anchored by rip-rap (or similar contrivances), to protect or to form revetment for river sides, or to form a jetty.

See instance of apron in Charleston Harbor improvements. "*Report of Chief of Engineers U. S. Army*," 1879, * i. 734.

Fig. 104.

Douglass' Aqua-pult.

Savannah River. *Ibid.*, * i. 742.

Fig. 103 shows a portion of a cross-section of an apron. It consists of rip-rap, lying on brush anchored by poles and founded on logs.

A'pron Fas'ten-er. A species of catch, resembling a buckle, used for fastening the apron cover on the dash-board of a vehicle. It consists of an apron hook and an apron ring.

A'qua-me'ter. A name for the pulsometer, a vacuum steam-pump. See AQUOMETER.

A'qua-pult'. A portable force-pump. The foot of the barrel stands in a bucket of water and the foot of the operator is on the step of the post *a*, Fig. 104. The pump being thus steadied, the handle is worked up and down, and the stream of water may be directed upon plants, fire, carriage, or what not.

A-qua'ri-um. The aquarium of Brighton is described in some detail, on p. 127, "*Mech. Dict.*," and reference made to parlor aquaria.

The late Exposition at Paris has furnished a most admirable work of the kind, shown in Plate II.

The aquarium is upon the hill of the Trocadéro, and is for fresh-water fish only. The site was quarried out of the hill, the natural rock being left to form the sides of the tanks and galleries. It covers a surface of 3,200 square meters.

The surface of the water is exposed to the rays of the sun, and light is admitted through the water to the grotto.

These tanks, 24 in number, are connected with each other in a gradually descending series, and the water overflowing each in succession is received into the one next below, the whole presenting, when viewed above ground, the pleasing appearance of a rivulet spanned by numerous rustic bridges and skirted by artistically planned and well-arranged walks. From these walks the visitor can observe the motions of the fish in the tanks below him, but a more accurate survey and closer observation can be had from the interior and lower level, where the fish are rendered plainly visible by reason of the effects of the light passing through the water.

The area of the walks on either side of the tanks is sufficient for the accommodation of 2,000 visitors at a time. The basins which contain the water are formed by the original excavations and artificial rock-work, made to imitate stalactites. These sustain the frames holding the glass plates, which are $\frac{86}{100}$″ in thickness, and number about 250 in all. The water used is the same as that supplied to the city of Paris, from the headwaters of the Vanne, and has a temperature during the summer of from 12° to 15° C. A supply can also be obtained from the Seine if necessary.

As the water is obtained very near the source of the river, it is deficient in oxygen, and in order to supply this element, so essential to the existence of the fish, an apparatus for aërating the water was introduced, the invention of M. Gauckler, chief engineer of roads and bridges, who was, in fact, the author of the original plan of the aquarium.

Some of the basins are 15′ in depth, and the total capacity of the tanks is about 2,000 cubic yards. Forty-six different species and varieties of fish are contained in the tanks, and one peculiarly interesting operation was performed in this aquarium in 1878: the hatching of 35,000 eggs of California salmon, sent by Prof. Spencer F. Baird to the French *Société d'Acclimatation*. Twenty-six thousand were hatched under the care of M. Carbonnier.

When it is remembered that the eggs were taken (artificially) from fish caught on the McCloud River, California, and thence transported across the American continent by rail, and across the Atlantic Ocean by steamship, the loss of only 10,000 eggs was a great triumph for American and French fish culture. The young fish were distributed as follows: —

To the Sarthe	5,000
To the Vienne	5,000
To the Yonne	5,000
To the Adour	5,000
To the Gave de Pau	5,000

The remaining 1,000 were placed in Tank No. 18 of the aquarium. The safe deposit of these fish in the above-named streams was a matter of great rejoicing to the French.

The cost of the aquarium was 50,000 francs.

The London Crystal Palace aquarium is 400′ long and 70′ broad, and the total capacity of all the tanks is 200,000 gallons of water, weighing 1,000,000 pounds. Of sea-anemones alone there are already in the aquarium over 3,000 specimens. These flower-like animals, being deprived in their captivity of the ocean currents which bring them their food, have to be fed at frequent intervals, each having given to it a morsel of food suited to its size.

See the following notices of aquaria: —

AQUARIA: "*Scientific American.*

At Paris	* xxxvi. 7; xxxv. 407; * xxxvi. 7.
At Brighton	* xl. 23.
At New York	* xxxv. 305.
At Westminster	* xxxiv. 200.
At Centennial	* xxxiv. 401.
Parlor, Directions for	xlii. 395.
Emptying	* xxxiv. 34.
Marine	* xxxv. 135; xxxvii. 202, 236.
Cement	xxxvi. 251; xxxviii. 250; xli. 59.

"*Scientific American Supplement.*"

At Paris	* 2116.
At Berlin Expos.	* 3751.

PLATE II

GROTTO AND AQUARIUM OF THE TROCADÉRO.
PARIS, 1878

See page 44.

At Westminster . . . . * 216.
At Birmingham, Eng. . . * 3008.
At Tynemouth . . . . * 2374.

"*Agriculturist.*"

Parlor . . . . . * xxxv. 145.

"*Engineering.*"

At Paris . . . . . * xxv. 42, 85.

"*Paris Exposition Reports.*"

At Paris . . . . . * v. 449.

"*Iron Age.*"

At New York . . . . . xvii. June 1, p. 17.

"*Mining and Scientific Press.*"

Ornamental . . . . . xxxv. 46, 60, 337.
With Bird-cage . . . . xxxvi. 113.

"*Manufacturer and Builder.*"

Parlor . . . . . x. 163.

"*English Mechanic.*"

Construction . . . . . xxiii. 45, 361, 387.
Construction and Suggestions . . . . . xxv. 212, 243, 266, 315, 345, 371, 391, 516.
Cement for . . . . . xxv. 319, 345, 368.
Marine, Notes on . . . . xxvi. 257
Rockwork . . . . . xxvi. 100; xxvii. 275, 557.

"*Appleton's Journal.*"

At Brighton . . . . . * xi. 1–5.

UNITED STATES PATENTS ON AQUARIA.

21,719	*Chilcott et al.*	Securing glass to corner posts.
22,019	*Davis* . . .	Mirror on rear plate.
31,040	*Shlarbaum* .	Suspended against a wall.
31,657	*J. A. Cutting*	Air forced into the tank.
46,801	*A. Ivers* . .	Flow and overflow pipes.
143,456	*J. Moore* . .	Flow and overflow pipes.
164,074	*J. Chase* . .	Aquarium, fernery, and bird-cage.
165,639	*Wenmacker*	Water-space inclosing an apartment.
188,941	*Peltier et al.*	Aquarium fountain and flower-stand.
192,595	*Paten et al.*	Arched-shaped water-chamber.

A'quo-me'ter. Prall & Burr's aquometer steam-pump acts by the direct pressure of the steam upon the water. It has two working chambers, and an intermediate pressure chamber. A double acting balanced valve alternately admits the steam to each working chamber where its pressure closes the water induction valve, opens the water eduction valve on that side, and forces the water contained in the chamber out into the discharge pipe. During this time the induction valve of the other chamber being open, and the eduction valve closed, that chamber becomes filled with water. The steam having expelled all the water from the other chamber, through the rapidity of its exhaust and condensation, a vacuum is formed in the chamber, the unequal pressure on the ends of the steam valve shifts that valve so that the steam passes into the other chamber which has now been filled with water by atmospheric pressure, and at the same time, the water valves in the one chamber are thrown into their proper positions to admit and retain the water ascending through the suction tube, and in the other to permit the water to be expelled therefrom by the steam pressure.

Fig 105.

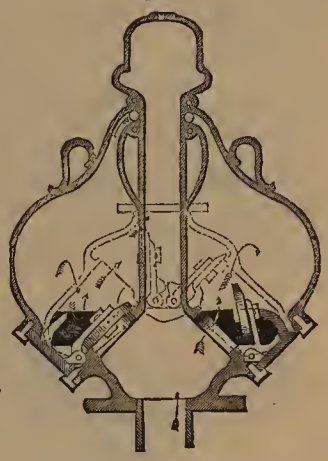
Aquometer. (*Elevation.*)

Burdon's vacuum steam-pump has been described under that caption on p. 2687, "*Mech. Dict.*" See also early forms, page 2336, *Ibid.*

Van Dusen's and Nye's are also forms of the same kind of apparatus.

Ar'bor, Ex-pand'-ing. A mandrel having a wedge-shaped feather, capable of being slipped so as to grip interiorly the hollow of a piece of work, or of a circular cutter.

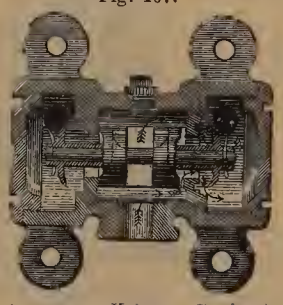
Fig. 106.



Aquometer. (*Vertical Section.*)

In Fig. 108, *C* is the steel maudrel; *B B* are two of the three keys that are drawn up and pushed down by the nut; a groove is turned inside the nut *A*, which catches the heads of the keys *B*, and thus draws them up to tighten the work; in the outside of the nut *A* is a taper hole which the pin *D* fits, and which answers for a wrench. *F* represents the tool operating on a piece of work.

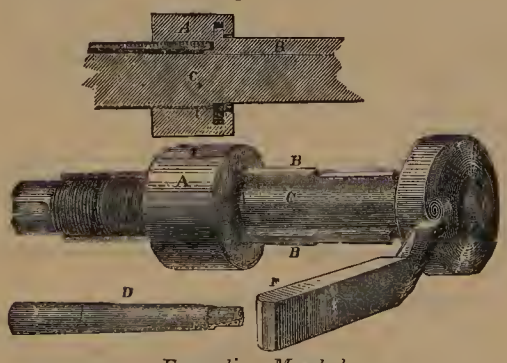
Fig. 107.



Aquometer Valve. (*Section.*)

Arch. (*Add.*) 2. (*Mining.*) A piece of ground left unworked near a shaft.

Fig. 108.



Expanding Mandrel

3. The fire-chamber of a furnace. The term is used especially in glass-furnaces.

4. The front opening of the ash pit beneath a furnace grate.

Arch Bar. 1. A bar forming a lintel to the mouth of an ash-pit; taking the place of the ordinary brick arch.

Fire-place arch bar, *Wickersham*, * "*Scientific American*," xxxv. 22.

2. The curved upper member of a round-topped truss.

3. A curved bar in a frame depending upon its camber for its stiffness.

Arch Screw Press. One in which the punch and its slide are supported on a frame arched above the die-bed; in contradistinction to one with an

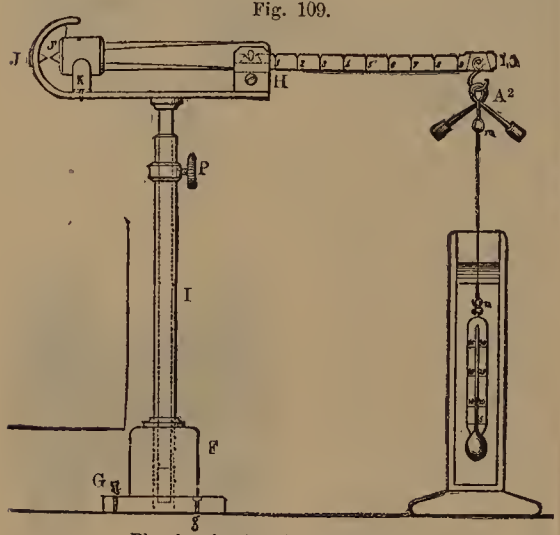
over-hang arm or bracket support for the punch-slide.

A′re-o-therm′ic Bal′ance. An invention of M. Blondeau for determining the density of liquids.

Its advantages are the facility with which the operations may be performed, and the readings taken, the approximation of the specific weight up to the fourth decimal, and its adaptation to liquids either heavier or lighter than water.

The instrument has a base, *F*, and leveling screw, *G*, and a hollow column, *I*, in which the stem of the upper part, *K H*, moves up and down, being held at any vertical adjustment by the binding screw *P*. *H* is a bearing for the knife edges that

Fig. 109.



Blondeau's Areothermic Balance.

support the beam ; *K*, the scale-beam guide ; *J J′* points to show the equilibrium of the beam. *A* 2, a weight which is suspended from the hook of the 10th division when the specific weight of a liquid heavier than water is sought. *M n*, hooks for suspension of the plunger with its thermometer, from the hook of the balance so that it may dip into the liquid whose density is sought, and which contains the test-glass. One of the arms of the beam carries at its extremity a cylindrical counterpoise, in the center of which is the point, *J′* ; and the other is divided into ten equal parts, numbered from 1 to 10. At each division there is an angular notch for receiving a weight. The method of regulating and using is described in a French paper translated and reproduced in "*Scientific American Supplement*," * 3773.

Ar′gen-tif′er-ous. (*Mining.*) Containing silver.

Ar′gen-ti′na. (*Ceramics.*) A name given by M. Hausen, of Stockholm, to his method of covering unglazed porcelain with a coating of gold, silver, or copper. The process is supposed to be as follows : The porcelain articles are dipped in a solution of the metal, similar to that used for electro-plating, and then, by a peculiar process of reduction (perhaps by means of phosphorus vapors), the salt is decomposed, and the metal is deposited within the pores of the earthenware. Articles covered with a metallic coating according to this process, present every appearance of being entirely composed of the metal.

Ar′ith-mom′e-ter. A calculating machine. A number of forms are shown in Figs. 325–329, pp. 143, 144, "*Mech. Dict.*"

Staffel's arithmometer is provided with an attachment, which, if an impossible operation, such as dividing a number by another larger than itself be attempted, stops the machine and rings a bell.

Ar′ith-mo-pla-nim′e-ter. An invention of M. Lalanne ; an extension of the principles of the planimeter for calculating certain formulas.

Reference is made at page 1728, "*Mech. Dict.*," to the planimeter of Oppikoffer, and the polar planimeter of Amsler is shown there in Fig. 3794.

The conical planimeter of Lalanne is furnished with longitudinal and transverse scales for calculations, and is shown in Fig. 353, Article "*Calculer*," tome i., *Laboulaye's "Dictionnaire des Arts,"* etc., edition 1877.

Arm. (*Surgical.*) A dry cupping chamber, inclosing the arm. See DEPURATOR, p. 687, "*Mech. Dict.*"

The apparatus is known as "*Junod's Arm*," from the name of the introducer in Parisian medical practice, about 1855 ; but it was patented in England by Smith, in 1802. It is a metallic receiver with an elastic band, to exclude access of air, the atmosphere being exhausted from the interior by an air-pump.

See, also, AËROTHERAPY APPARATUS.

Ar′ma-dil′lo. An electro-magnetic remedy for nervous diseases. It consists of a number of voltaic elements, copper and zinc for instance, flexibly jointed together as plates, in shapes for belts, shoe-soles, etc, and worn on the body, limbs, feet, as the case may be.

Fig. 110.

Arm Boxing Machine.

Ar′ma-ture. (*Electricity.*) The bar at the end of the helix, by which the circuit is opened and closed.

Numerous forms are shown in treatises on electricity. A compend is given in "*Scientific American Supplement*," * 2,900. See, also DYNAMO-ELECTRIC MACHINE, and list under ELECTRICITY.

Arm Box′ing Ma-chine′. A machine for boring the hubs of wheels for the reception of the box for the arm of the axle. The wheel is held, chucked as it were, by three equidistant points on the rim, and the boring device thus presented at the exact center, at right angles to the plane of the wheel.

Ar′mor Com′pound. Ship's armor, having a steel face and iron backing. Made under English Patents to Ellis and Wilson, by Messrs. Brown and Cammell, of Sheffield, England, respectively. See "*Iron*," 1879.

The steel does its work in preventing penetration by causing the shot to break up on impact, and the more tenacious and ductile iron performs its part in preventing the destruction of the steel by being shivered.

In making the compound armor, the liquid steel is poured upon the hot iron plate, the heat of the former being in excess of the welding heat of the latter, and a semi-steel is formed between the two

by fusion. Steel-faced iron plates are the latest improvement in the art.

The iron plates are placed horizontally in a furnace when a steel plate is to be cast on to a single iron one, but when a steel plate is to be sandwiched between two of wrought iron, the latter are fixed vertically and the steel run in between them. This is Wilson's plan; that of Sir Joseph Whitworth proceeds on quite a different principle, that of plugging a shield of soft steel with pins of harder quality.

Ar'mor Plate. An iron or steel skin for a vessel of war. See Figs. 337–358, and Plate IV., pp. 150–155, "*Mech. Dict.*" See, also:—

Experiments	*	"*Sc. Am. Sup.*," 931.
Trial, Shoeburyness	*	"*Sc. Am. Sup.*," 2013.
Plates and Projectiles		"*Iron Age*," xx., July 5, p. 15.
Plate Machine, Br.	*	"*Engineer*," xlii. 183.
		"*Sc. Am.*," xxxiv. 247.
		"*Sc. Am. Sup.*," 789.
Chilled Cast Iron, Ger., *Gruson*	*	"*Engineer*," xlviii. 465, 468.
Compound. Eng.		"*Sc. Am. Sup.*," 1732.
Br., *Brown and Cammell*		"*Iron Age*," xxiv., Aug. 14, p. 14.
Compound	*	"*Sc. Am. Sup.*," 1789.
Effect of Shot and Shell	*	"*Engineering*," xxvii. 70.
Furnace, Br., *Wilson*	*	"*Engineer*," xliv. 419.
Wilson	*	"*Sc. Am. Sup.*," 1789.
Iron and Steel		"*Nautical Magazine*."
		"*Van Nostrand's Magazine*," xxi. 28.
Steel, Eng.		"*Sc. Am. Sup.*," 1777.
		"*Sc. Am.*," xl. 312.
Targets, Eng.	*	"*Sc. Am. Sup.*," 2357.
Whitworth's		"*Sc. Am. Sup.*," 2145.
Yates		Patent March 13, 1877.
		"*Sc. Am.*," xxxvi. 407.
Gun, *Krupp*		"*Van Nostrand's Mag.*," xvi. 285.

Consult:—

A. L. Holley's "*Treatise on Ordnance and Armor*," 1865.
Earl's "*System of Naval Defences*," 1868.
Reed's "*Our Iron-clad Ships*," London, 1869.
"*Ship-building in Iron and Steel*," 1869.
Dislère's "*La Marine Cuirassée*," Paris, 1873.
King's "*Report on European Ships of War*," Ex. Doc. xxvii., 1877.
Secretary of Navy's "*Report on Armored Vessels*," 1864.
Noble's "*Report on Penetration of Armor Plates*," 1876.

Arm Sling. (*Surgical.*) A wire gauze cradle for a fractured or dislocated arm, supported by a sling over the shoulder.

Tiemann's "*Wire Arm-sling.*" Fig. 152, p. 93, Part IV., "*Armamentarium Chirurgicum.*"

Arm Splint. (*Surgical.*) A stiffening bandage apparatus, for holding parts in position rigidly during the junction of the bony parts, in cases of fracture, or the parts in position in cases of luxation.

The splints are various, according to the part and nature of the fracture. Reference to *Tiemann's* "*Armamentarium Chirurgicum*," Part IV.:—

Clavicle	*Levis*	Fig. 123, p. 76.
Clavicle, Scapula, and Humerus	*Richardson*	Fig. 124, p. 76.
Colles's Fracture	*Hewit*	Fig. 128, p. 79.
	Shrady	Fig. 129, p. 79.
Elbow	*Hamilton*	Fig. 148, p. 91.
Neck of Humerus		Fig. 149, p. 92.
Dislocated Clavicle	*Mayor*	Fig. 150, p. 92.
Olecranon	*Clark*	Fig. 153, p. 94.
Ununited Fracture of the Humerus	*Smith*	Fig. 172, p. 109.
Ununited Fracture of the Forearm	*Smith*	Fig. 173, p. 110.
Elbow and Wrist	*Andrew*	p. 123.
Contracted Wrist		Fig. 208, p. 135.

Ar'mure. (*Fabric.*) 1. The character of the weave.

The system of harnesses with which the loom is *armed*, or provided, to produce a definite tissue.

There are four fundamental or classical forms, from which all the varieties of simple tissues are derived.

(*a.*) *Taffeta*, having 2 harnesses, forming a single interlacement.

(*b.*) *Twilled*, or *Batavia Weave*, 4 harnesses.

(*c.*) *Serge*, having 3 harnesses.

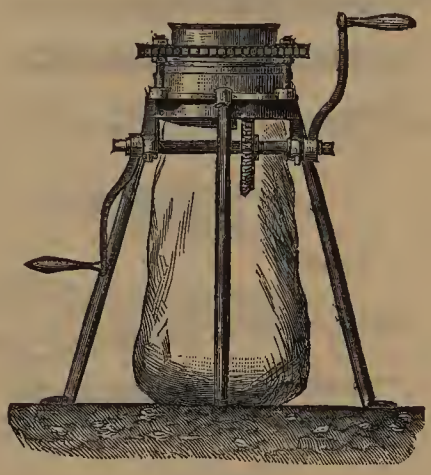
(*d.*) *Satin*, 5 or more harnesses.

See under those heads. See also FABRIC.

2. A silk and wool French dress goods.

Ar'my Mill. A portable mill standing on a tripod, driven by two men at the hand cranks, and grinding into a sack suspended beneath. It is a French invention, costs $40, grinds 44 pounds per hour, and four of them, packed in two boxes, are a load for a mule on the march.

Fig. 111.



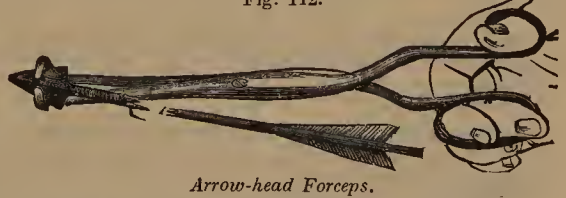
Army Mill.

Ar'my Scales. A portable form of scales which closes up in a box compact for transportation; such scales have a capacity from 600 to 1,200 pounds. When closed, the working parts are entirely protected.

Ar'rage. (*Mining.*) A sharp edge or corner in an adit or drift. —*Arris.*

Ar'row-head For'ceps. (*Surgical.*) An instrument for the extraction of the heads of Indian arrows, which frequently are purposely made to become detached from their shafts.

Fig. 112.



Arrow-head Forceps.

Ar-te'ri-al Com-press'or. (*Surgical.*) A clamp, to be placed upon an artery to prevent effusion of blood.

Speir's artery constrictor is a species of hook, pulling into a case and clamping the artery. Fig. 87, *Tiemann's* "*Armamentarium Chirurgicum*," Part I.

Billroth's artery clamp is a small screw clamp, holding the artery between curved plates. Fig. 91 *b*, *Ibid.*

Stearns' artery claws are bows of pliable but not flexible metal, pinched upon the artery by forceps. Fig. 89, *Ibid.*

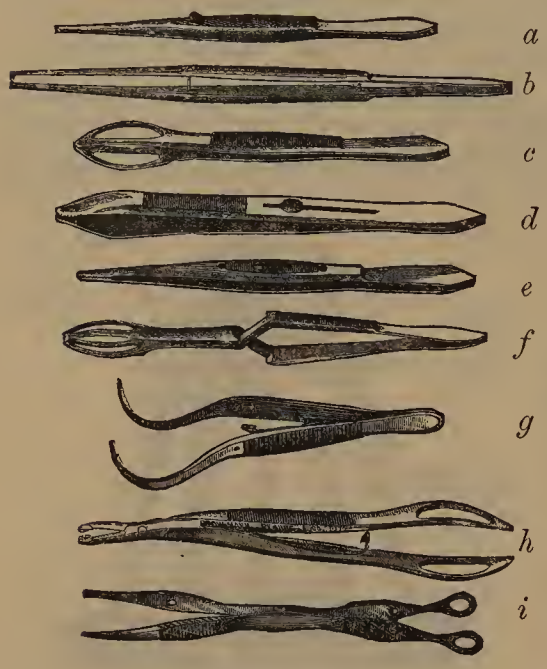
Artery compressors in lieu of tourniquets during amputation.

Erichson's	Fig 108.	
Buck's	Fig. 109.	
Skeys	Fig. 110.	*Ibid.*, Part I.

Ar'te-ry Con-strict'or. (*Surgical.*) A hook-ended instrument capable of being introduced into a wound to grasp and pinch an artery to prevent effusion of blood. See ARTERY COMPRESSOR.

Ar'te-ry For'ceps. An instrument for catching an artery and holding it while being ligated. There are numerous forms, but all are of the nature of tweezers or nippers.

Fig. 113.



Artery Forceps.

a. Spring-catch forceps.
b Massachusetts General Hospital forceps, with five teeth.
c. Spring-catch fenestrated forceps.
d. Dugar's slide-catch forceps.
e. Combined artery and needle forceps.
f. Fenestrated self-holding forceps.
g. Wight's curved forceps.
h. Stohlmann's combined needle and artery forceps.
i. Cleborne's double forceps.

See, also, TORSION FORCEPS.

Ar'te-ry Nee'dle. (*Surgical.*) A curved needle, or thread-carrying hook, for passing a ligature around an artery.

See ANEURISM NEEDLE, Fig. 211, p. 102, "*Mech. Dict.*"

Suture, ligature, and ruptured perineum needles are similarly formed, but have some special characteristics; p. 28, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Ar'te-ry Scis'sors. (*Surgical.*) An instrument having on one blade a prolonged gorget-end to follow the artery. Fig. 149, p. 48, Part I., "*Armamentarium,*" *ut supra.*

Ar-te'sian Well Ma-chine'. Fig. 114 is a boring machine for artesian and other deep wells, operating by means of the diamond rock drill.

The foot of the drill rod is shod with an annular ring of black diamonds, and the rod is rotated by steam engine and intermediate gearing. The rod is lowered or raised by steam pressure in the pair of vertical cylinders attached to the frame, acting upon a yoke which is clamped to the rod when required. Consult: —

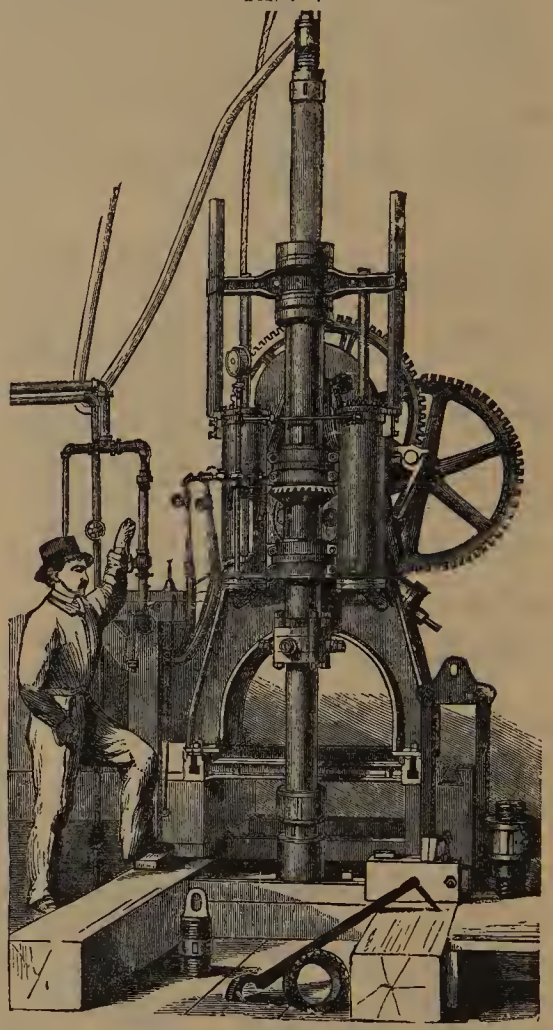
Artesian Well.

Charleston	"*Sc. Am.,*" xxx. 150.
Pesth, Hungary, 3,120′, 161° F.	"*Sc. Am. Sup.,*" 1972.
Pesth, Hungary	"*Sc. Am.,*" xxxviii. 47.
San Francisco	*"*Sc. Am. Sup.,*" 2473, 2518.
Vittoria, Spain	"*Sc. Am.,*" xxxix. 291.
Boring Tools	*"*Sc. Am. Sup.,*" 2526, 2543.

Ar-tic'u-la-ting Tel'e-graph. A name for the telephone.

Ar-tif'i-cer's Knot. A form of knot in which a rope is bent around a spar or handspike so as to jam when pulled taut. It is shown at 8, 9, Fig. 2777, p. 1240, "*Mech. Dict.*"

Fig. 114.



Artesian Well Boring Machine.

Ar'ti-fi'cial Moth'er. A warm chamber for young chicks; made as a substitute for a brooding hen to foster the young birds hatched in an incubator.

The brooding chamber has a long napped blanket and is heated with hot water, by a lamp, or in some cases by fermenting manure. The villous coating of the chamber walls and ceiling afford nestling places for the young birds.

Ar'ti-fi'cial Stone. See STONE, ARTIFICIAL; MARBLE, ARTIFICIAL; BÉTON, etc.

Art, in various materials. See under the following heads: —

Amatorii.	Carving.
Applique.	Casing.
Argentina.	Champ-levé.
Automaton.	Chasing.
Aventurine.	Checking.
Bat printing.	Cire-perdue.
Bidiri ware.	Cloisonné.
Black basalt ware	Coin.
Black glass.	Colored glass.
Blacking.	Crackle-ware.
Bohemian glass.	Cream-ware.
Bone porcelain.	Crystal.
Bronzed glass	Damasceening.
Bronzing.	Damasking metals.
Cameo cutting.	Decalcomanie.
Cameo glass.	Deglazing.
Cameo incrustation.	Delft ware.

Depolishing.
De-vitrification.
Diamond.
Doubled-glass.
Doulton ware.
Egg-shell ware.
Electro-plating china.
Email ink.
Enamel.
Enameled glass.
Encaustic.
Encaustic tile.
Engraved colored glass.
Engraved glass.
Etched enamel.
Etched glass.
Etching on porcelain.
Faïence.
Faïence d'Oïron.
Faïence stannifère.
Feathers, artificial.
Filigree glass.
Fine art metal-work.
Flag.
Flashed glass.
Flat chasing.
Flooring tile.
Flowers, artificial.
Fluted glass.
Frosting.
Gem, artificial.
Gem engraving.
Gilding on glass.
Glass carving.
Glass cutting.
Glass enamel.
Glass engraving.
Glass etching.
Glass polishing.
Glass silk.
Glass silver.
Grafito.
Half clear.
Hard paste.
Heliogravure.
Henri-Deux ware.
Hyalithe.
Incrusted work.
Inlaying.
Iridescent glass.
Iridiated glass.
Irisated wire.
Irisation.
Ivory-dyeing.
Ivory porcelain.
Ivory work.
Jasper ware.
Jet.
Jewelry.
Kuft work.
Lac work.
Lacquer.
Luster.
Majolica.
Marbleized glass.
Metalized glass.
Metal seal.
Mezza-majolica.
Milling.
Mirror.
Mixed-clay ware.
Modeling clay.
Modeling wax.
Mosaic.
Mosaic glass.
Mousselaine glass.
Mural tile.
Murrhine.
Muslin glass.
Niëllo.
Oïron ware.
Onyx glass.
Opal glass.
Orugo.
Palissy ware.
Parcel gilt.
Parian biscuit.
Pâte changeante.
Pâte-sur-pâte.
Patina.
Pearl.
Pearl inlaying.
Piercing.
Plaque.
Plaster bronzing.
Plaster casts.
Plastic crystal.
Plastilina.
Platinizing glass.
Porcelain.
Porcelain pâte tendre.
Pottery.
Rafaëlle ware.
Repoussé.
Rose glass.
Ruby glass.
Satining.
Sculpture.
Seal.
Sèvres porcelain.
Sgraffito.
Silvering glass.
Silver glass.
Snarling.
Soft paste.
Spinning.
Spun glass.
Staining wood.
Stanniferous glaze.
Stoneware, decorated.
Tender porcelain.
Terra-cotta.
Terre-cuite.
Tile.
Tissue glass.
Tortoise-shell ware.
Transfer printing.
Ultramarine.
Under-glaze.
Wax flowers.
Wedgwood.
Zinc decorating.

As-bes'tos. A curious fibrous mineral; a variety of hornblende and pyroxene. It is found in many parts of the world, is of very various qualities, and requires careful preparation for some of the uses to which it is applied. See p. 167, "*Mech. Dict.*"

In the application of asbestos, it is used loose, or is made into sheets, felt, boards, braid, or rope, sometimes with a cementing substance, such as paper pulp, cement, mortar; or as a covering or lining to hair-felt, to prevent the charring of the latter when used as a covering to steam boilers and pipes.

For steam-packing the fibres are covered with braid, and made in coils of convenient length.

As a paint, it is mixed with metallic pigments, and used on wooden structures, roofs, ceilings, and partitions.

The best asbestos is found in Italy. An exhibition of asbestos has recently been held at the Simonetti Palace in Rome; the material in numerous different crude forms being exhibited, as also all the known applications of it in the useful arts. The cabinet of Mr. C. A. Wilson, of Genoa, is said to contain one hundred distinct varieties from the Alps. It is largely exported from Italy to the United States.

See "*Waste Products and Undeveloped Substances*," by Simmons. London, 1876.

The uses of Asbestos are recited on pp. 167, 168, "*Mech. Dict.*": —

Absorbent in lamps.
Boiler covering.
Coffins.
Cremation shrouds.
Electric insulators.
Fire brick and crucibles.
Firemen's clothes.
Flooring cement.
Fuel bed for petroleum.
Ink.
Journal bearings, Ingredient in.
Lamp-wicks.
Molded articles.
Paper.
Piston and rod packing, either in rope or loose form.
Porcelain.
Refrigerators.
Roofing cement.
Ropes.
Safes.
Wrapper for articles to be consumed.
Yarn.

To these may be added: —

Cellar ceilings, to prevent radiation of heat.
Sheathing paper, for walls and ceilings.
Fire-proof boxes, for shelves, etc.
Theatrical scenery.
Converting hydro-carbon into gas fuel.
Packing and lubricant, Jennings; U. S. Patent, 1828.
Mill boards, for steam joints.
Gaskets, for man-hole plates.
Filtering acids.

It is used in the shape of trays of cardboard, for containing molten metals at high temperature.

As a sponge, to contain concentrated sulphuric acid in that form of lighting apparatus known as *oxygénés*, No. 18 of the series of *lighting devices* recited on p. 1315, "*Mech. Dict.*"

Ashestos is used in Italy as a fire-bed in a furnace, petroleum being poured thereon and burned beneath the steam boiler. — *Scientific American*, xxxvi., 217. Modifications of this form the subjects of many patents in England and the United States.

See, also, Asbestos Stove, p. 168, "*Mech. Dict.*"

As a coating for metals in a furnace: —

Fire Clay, Soap-stone, Asbestos } *Nes* . . . . Patent 104,873, June 28, 1870.

British Patents.

No. 145 Lamp-wick, silk and asbestos woven together.
2,647 Plaited and felted asbestos for wicks.
1,413 Asbestos pulp for paper. Boiled; fibres segregated and mixed with alum.
6,555 Safes.
2,048 Lubricant of asbestos, mercury, fat, and oils.
213 Lubricant of asbestos and clay. (*Laubereau.*)
362 Insulator, and non-conductor in electrical apparatus.

United States Patents.

1870. Refrigerators, as a non-conductor. (*F. Hyatt, U. S.*)
1828. Packing for pistons, piston-rods, pump plungers, joints, etc., etc. (*Israel Jennings.*)
August 22, 1865. Lubricant: asbestos, soapstone, and cotton. (*Devlan.*)
March 29, 1870. Cord in a rope packing of asbestos. (*Stevens.*)
October 4, 1874. Loose asbestos packing. (*Botticher.*)
November 8, 1870. Asbestos, graphite, and iron filings. (*Kelly.*)
1868. Made into sheets with felt or pulp. (*Johns.*)
September 18, 1866. In carburetors. (*Bassett.*)
August 14, 1866. In lamps as an absorbent. (*Beschke.*)
Nos. 112,647 and 112,648, Packing. (*Stevens.*)
Nos. 112,649 and 112,650, Mode of treating asbestos. (*Stevens.*)

See under the following references: —

"*Engineering.*"

Faucet Packing, *Dewrance.* xxi. 68.

"*Mining and Scientific Press.*"

Uses . . . . . xxxiii. 180, 344, 433; xxxvii. 232, 297, 393.
Felt . . . . . xxxvi. 307.

"*Engineering and Mining Journal.*"

Powder . . . . . xxi. 347.
California Mines . . . . xxiv. 404; xxix. 86.
At Rome . . . . . xxii. 141.
Patents . . . . . xxii. 347; xxiv. 328.
Pipe Covering . . . . . xxvi. 443.

Packing . . . . . xxvi. 58.
Uses . . . . . xxx. 444.

"*Scientific American.*"

At Italian Exposition . . . xxxv. 79.
Roof and Boiler Covering . * xxxiv. 258; xliii. 357.
Uses and History . . . . xxxv. 392; * xxxiv. 258.
Fire Surface . . . . . xxxvi. 217.

"*Scientific American Supplement.*"

Packing . . . . . 2947.

"*Polytechnic Review,*" *August* 26, 1876.

"*Leffel's Milling and Mechanical News.*"

Uses . . . . . * vi. 31.

"*Iron Age.*"

Uses . . . . . xix., Jan. 11, p. 15; xx., Sept. 13, p. 7.
Fire Surface . . . . . xix., May 24, p. 1.
Roman Exhibition . . . . xviii., Sept. 28, p. 1.

"*Manufacturer and Builder.*"

Uses . . . . . ix. 102, 127; viii. 176; xii. 227; x. 65; xi. 68.
Paint . . . . . xi. 236.
Artificial . . . . . x. 5.
Roofing . . . . . ix. 102; xii. 228.
Boiler Covering . . . . . ix. 102; xii. 31.

"*American Railroad Journal.*"

Fire-proofing . . . . . liii. 160, 193.
Mineral Wool . . . . . liii. 843, 1231.

"*Telegraph Journal.*"

Uses . . . . . v. 285.

"*English Mechanic.*"

Fire Surface . . . . . xxiv. 440, 531.

"*Engineer.*"

Asbestos and Patents . . . xlii. 396.
Cardboard . . . . . xliii. 352.

"*American Builder,*" xiii. 9.

See paper by Mr. Lloyd, "*Philosophical Transactions,*" vol. xiv., p. 823, A. D. 1684. See "*Abridgments,*" vol. ii., pp. 548-554. Several articles.

See, also, "*Munsell on Paper,*" pp. 20, 25, 102.

As-bes'tos Felt. Mr. F. A. Gooch, of Cambridge, Mass., describes a mode of preparing a felt of anhydrous asbestos for filtering material.

The felt is prepared by scraping white silky asbestos to a fine, short down, boiling it with hydrochloric acid, and washing it by decantation. It is then deposited, by the aid of the Bunsen pump, on the bottom of a platinum crucible perforated with fine holes; or, better, the bottom may be made of fine platinum gauze. The process is described in the proceedings of the American Academy.

As-bes'tos Pa'per. *Rosenthal's* method of disintegration of asbestos, for paper-making, is as follows: —

The asbestos is put into wooden tanks lined with lead, covered with water, and chemicals added. Steam is introduced, and it is boiled four to six hours. When disintegrated it is passed through a pair of rolls, the top one covered with rubber, and a rubber apron running on the lower one, by means of which the water is driven from the fiber. It is then dried, and manufactured into board on a special machine.

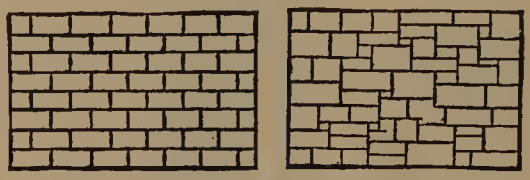
The Italian asbestos paper costs 40 cents per pound. The paper mills are at Tivoli, where Victoria made his successful attempt to manufacture this paper, which is specially adapted for valuable documents, etc. It has recently undergone most conclusive tests by the Marquis de Bariera at an exhibition of objects made of this substance, held in Rome. Two card-board boxes containing papers, one made of ordinary material and the other of asbestos, were thrown into the fire. The former was entirely consumed, while the latter remained intact, together with the papers it contained. It is also made into theatrical hangings. This is an excellent use of it. — "*La France Nouvelle.*"

As-cen'sion. (*Mining.*) The theory that the matter filling fissures was introduced from below.

Ash'lar. (*Masonry.*) Cut stone masonry.

When regular, it is *ashlar;* but when smaller cut stones break the regularity, it is called *broken ashlar,* as in the right hand illustration.

Fig. 115.



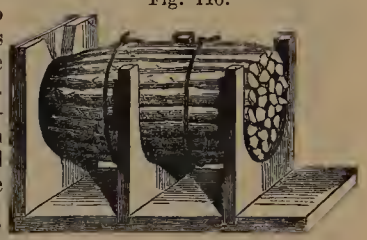
Ashlar.

Small ashlar, when the assizes are less than a foot in height.

Rough ashlar, squared, when the face is only quarry-faced or pitch-faced.

As-par'a-gus Buncher. The Sartrouville buncher, shown in Fig. 116, has two U-shaped frames in which the sprouts are laid, the tips symmetrically gathered in the contracted space, and the bunches tied.

Fig. 116.



Asparagus Buncher.

As-phalt' Pave'ment. Asphalt is limestone saturated with bituminous matter. — *Léon Malo.*

The first quarry opened and worked was the famous bed of Val de Travers, on the Neufchâtel Pontarlier Railroad, Switzerland. The bed extends over a distance of six miles, and is 1.75 miles wide. The thickness of the bed varies from 3 to 16 feet, the annual production of the mine fluctuating between 40,000 and 50,000 tons, occasionally exceeding the latter figure. The deposit was first discovered in 1712 by Eirinus, a Grecian physician, who obtained mineral rights from the King of Prussia, at that time in possession of Neufchâtel. Eirinus sold the product obtained by him chiefly as a cement for woodwork, masonry, etc., exposed to water.

Eirinus finally abandoned Val de Travers and went to Alsace, where he opened new mines. After his death the asphalt industry collapsed entirely, other parties who obtained control of the mines using them for distilling oils which were sold as wonderful remedies. It was not till 1802, when asphalt beds were discovered at Seyssel, on the banks of the Rhône, France, that a new impetus was given to an industry which has since steadily grown in importance.

Natural asphalt must contain nothing else but carbonate of lime and bitumen, and the latter must thoroughly impregnate the rock, the grain of which must be as fine as possible. It must not contain less than 7 per cent., and not more than 11 per cent., of bitumen, and the latter itself must not, when warmed for a long time, lose more than 2 per cent. by weight. Greater loss indicates that bitumen is not wholly tarry matter. The following analyses show the composition of the asphalt from the most important mines of the Continent, No. I. being from Val de Travers, No. II. from Seyssel, and No. III. from Lobsann, in Alsace: —

	I.	II.	III.
Water and other substances evaporating below 90° C	0.50	1.90	3 40
Bitumen	10.10	8.00	11.90

Carbonate of lime	87.95	89.55	69.00
Carbonate of magnesia	0.30	0.10	0.30
Mineral matter insoluble in acids	0.45	0.10	3.05
Other substances	0.70	0.35	2.90
Sulphur			5.00
Sulphuret of iron			4.45
Total	100.00	100.00	100.00

The asphalt rock is blasted with the aid of powder, dynamite having proved inefficient, probably owing to the elasticity of the rock. It is ground, or, rather, torn to pieces between two rollers rotating at different velocities and provided with steel teeth, a 10 to 12 horse-power mill being capable of reducing to suitable size from 8 to 12 tons of rock per hour. The grinding is completed in a 22 to 25 horse-power Carr disintegrator, running at a speed of 500 revolutions per minute, and turning out 5 tons of powdered rock per hour. The fine asphalt is then melted in a cast-iron semicylindrical vessel, provided with a system of mixing knives attached to a shaft. During the operation a varying quantity of mineral pitch is added. For a 3-ton vessel this operation lasts about 3½ hours, the greatest care being taken not to allow the temperature to fall below 175° C., or go above 230° C. The product thus obtained is called "mastic," which possesses the valuable property of rendering the asphalt capable of being melted, while the asphalt rock alone would only be converted into a powder even by the application of the highest temperatures. As soon as the mastic is thoroughly mixed, it is run into molds. For use, the bricks are broken up and melted with a small quantity (from 2 to 3 per cent.) of pure pitch, and from 30 to 40 per cent. of clean gravel.

See PAVING.

Asphalt	"*Sc. American Sup.*," 1939.
Asphalt and Wooden Road Construction, On, (10 Figs.)	* "*Engineer*," xlvi. 117.
Asphalt Manufacture	"*Iron Age*," xxi., Jan. 17, 3.
Asphaltum, Manufacture of	"*Sc. American Sup.*," 1176.
Asphaltum Road-making	"*Man. & Build.*," xi. 143.
Asphalt Tiles	"*Sc. American*," xxxvi. 7.
Asphalt Pavements of Paris	* "*Sc. American*," xxxix. 65.

As-phalt', Ar'ti-fi'cial. The "Lyons" asphalt, introduced by M. Gobin into Belgium, is composed of 15 parts of bitumen, 35 parts of coal slack, 10 parts by weight of coke powder, 130 parts of lime, and 160 parts of fine gravel. The bitumen and coal slack are mixed together in a boiler, and skimmed until the formation of a scum ceases. The coke powder and lime are mixed, heated to about 300° C. in order to dry them, and then they are added to the material in the boiler. The gravel is embodied in the mixture as the last ingredient.—"*Moniteur Industriel.*"

As-phalt' Tiles. In a Bavarian method of making flooring tiles from asphalt, the drawing of the intended design is first made on coarse, heavy paper. This is then covered with bits of china and glass, so as to form a mosaic. Lastly, a border is made to the sheet, and liquid asphalt is poured upon it. After the whole has been covered, the paper is taken away with cold water, and the tile is finished.

As-phalt'o-type. (*Photography.*) The process of Niepce; producing the image on a plate covered with bitumen of Judea. See pp. 673, 1683, "*Mech. Dict.*"

As-phal'tum. See paper on Petroleum, Bituminous Rocks, Shales, Asphaltum, etc., *Brodhead's* Report of Group I.; *Centennial Report*, vol. iii., including:—

	Page		Page
Petroleum	3	Shales of New South Wales	11
Bituminous rocks in America	10	Albertite	12
Grahamite	14	Coörongite	17
Asphaltum	14	Kauri gum	18
Asphalt	16	Amber	18
Ozocerite	16		

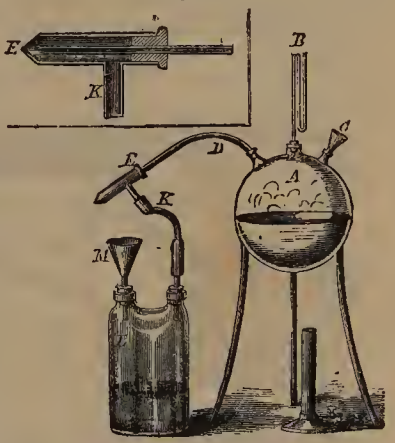
As'pi-ra'ting Fil'ter. One in which the action is expedited by the withdrawal of air from beneath the filtering material.

Fig 117.

Aspirating Filter.

By compressing the rubber ball in the hand, the slit in the India-rubber tube, which acts as a valve at *B*, closes, and the air it contains is ejected through the valve at *C*. On removing the pressure from the ball, valve *C* closes by atmospheric pressure, leaving a partial vacuum in the ball; air passes from the flask through valve *B* into the ball, to restore the equilibrium, and a partial vacuum is created in the flask which is increased by a second squeezing of the ball. The liquid material in the filter, in consequence, will be rapidly forced into the flask by atmospheric pressure on its surface. —*Partridge.*

Fig. 118.

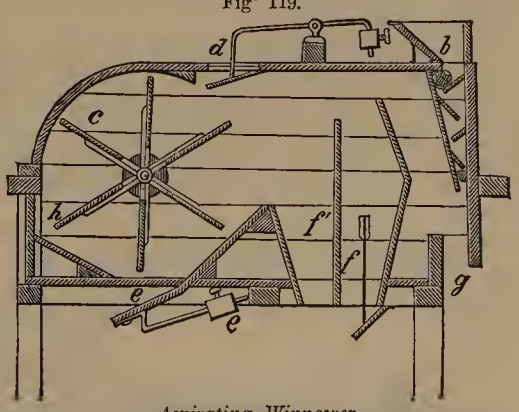


Steam Aspirating Filter.

The aspirating filter apparatus, Fig. 118, operates by steam generated in the globe *A*, which passing by *D* into *E*, issues at the point of the latter, drawing with it through *K* the air from the bottle *L*. *M* is the supply funnel; B, the steam-gage; *C*, water supply.

As'pi-ra'ting Win'now-ing Ma-chine'. One which draws air through the grain instead of blowing it. Action by suction instead of blast. This is very common in the United States in smut mills and machines of that class, but the principle is

Fig 119.



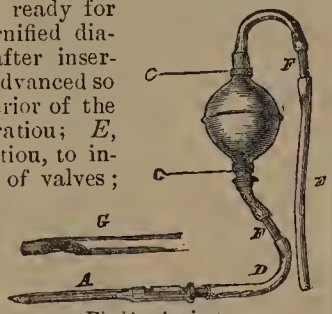
Aspirating Winnower.

more commonly adopted with winnowers in France than with us. Fig. 119 is a French machine. The fan *c* draws air in the direction of the arrow. The grain, falling from the hopper *b*, meets the

blast entering at *g*, and, according to the comparative levity of the grain, seeds, chaff, dust, etc., each falls or issues at compartments *f*, *f'*, *e h*. *d* is a counterbalanced valve, by which the force of the in-draft is regulated. *e* is another regulator.

As'pi-ra'tor. An apparatus or instrument for drawing air. In Fig. 120, *A* represents the dome aspirator-needle, with the cutting point projected, ready for puncture; *G*, a magnified diagram of the same, after insertion, with the dome advanced so as to protect the interior of the cavity during aspiration; *E*, bulb in upright position, to insure the best action of valves; *C C*, valves; *D*, entrance tube; *E*, exit tube; *F F*, bits of glass tubing, through which to observe the presence or absence of fluid. — "*New York Medical Journal*," November, 1877.

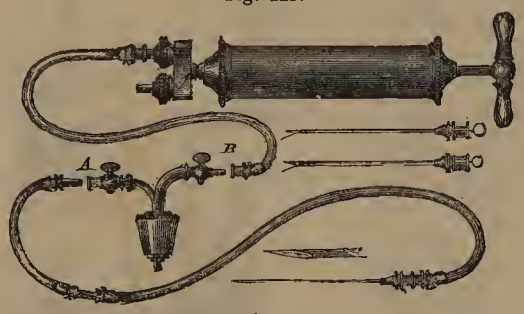
Fig. 120.



Fitch's Aspirator.

Fig. 121 is an aspirator which can also be used as an injector. The instrument consists of three needles of assorted sizes, a rubber stopper which fits into a jar, and through which passes a double-current tube provided with stop-cocks. This communicates by an elastic hose, at *B*, with a pump, and at *A*, by another hose, with the needle or capillary tube to be used.

Fig. 121.



Aspirator.

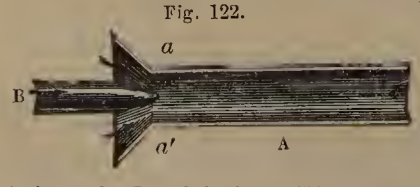
By putting the stopper in the bottle, closing the cock *A*, opening *B*, and giving 25 or 30 strokes of the pump, the air is exhausted from the bottle; then close *B*, and the apparatus is ready for use. The tube is introduced, and cock *A* being opened, aspiration commences.

To inject with the same instrument, connect the air-tube with the outward flow of the pump; put the desired liquid in the bottle, and, while holding the latter in reversed position, pump air into it. After having obtained the desired pressure in the bottle, close *B*, and detach the pump; introduce the tube into the object to be injected, and open *A*.

The rotating aspirator point for use as a trocar is a flat blade twisted. — *Dr. Warren.*

Aspirators are used in trades which produce deleterious dust, also to remove shavings and sawdust from wood-working machinery.

Fig. 122.



Aspirator for Dry Grinding. Châtellerault.

Various principles are used. The Sturtevant suction fan is employed. At the works of Châtellerault, in France, the jet of compressed air is used. *A* is a cylindrical tube, having a length at least five times its diameter. *B* is a tube throwing a jet of compressed air into the tube, the air at the rear being drawn forcibly through the passage *a a*[1] by the suction produced.

Another form of aspirator is that used in ventilation; in fact, any exhaust pump or suction fan comes within the definition. Such are used in buildings of importance, hospitals, public buildings, and halls; also in mines.

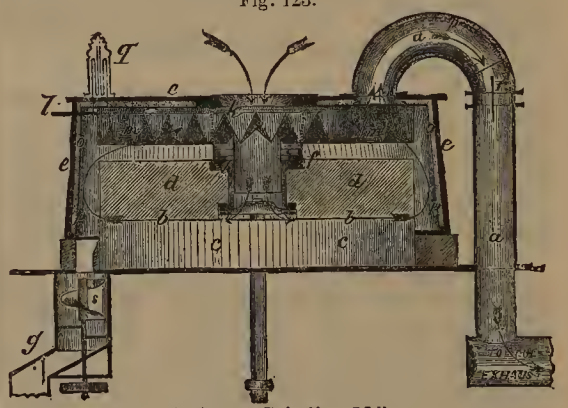
Such machines operate on various principles: the piston, revolving fan, inverted caisson resembling a gas-holder. The former two are shown in Figs. 5, 6, *Laboulaye's "Dictionnaire des Arts et Sciences,"* tome iii., article "*Ventilation.*"

The hydro-pneumatic aspirator of M. Legat has been applied to paper-making machinery, to replace the air-pumps, which serve to make a vacuum beneath the web, on which the pulp collects to form paper. The effect of the withdrawal of the air from beneath the web is to drain out the water of the pulp, which becomes solidified sufficiently to take off and pass to the calenders.

The hydro-pneumatic aspirator is on the principle of the Giffard injector, and a view and description of it are given in Fig. 3,237, *Laboulaye's "Dictionnaire des Arts et Sciences,"* tome i., article "*Aspirateur.*"

Fig. 123 shows the aspirating principle applied to grinding-mills, to prevent the accumulation of flour dust in the husk. It is the invention of MM. Jaacks and Behrns, of Lubeck, Germany.

Fig. 123.



Aspirator Grinding Mill.

A fan exhausts air through the pipe *a*, from the mill-stone hoop, and fresh air enters with the wheat at the eye of the stone and passes between the buhrs, *dd*, *cc*. The hoop is air-tight, and has but the one inlet, *k*, and two outlets: one at *g* for the chop, and the other at *a*, for the warm and damp air. Leakage of air at the eye is prevented by an arrangement of two rings, *h*, *i*, one fast to the stone, and the other suspended by a leathern cylinder from the hoop *e*. The screw *s*, in the chop tube, presses out the meal, which is sufficiently tightly packed therein to prevent passage of air.

In order to retain the flour-dust within the hoop a cloth of long-haired flannel is stretched and laced up in zig-zag shape over a frame, *m*, which is suspended by hooks under the top of the curb, and the flannel is tacked loosely, but dust-tight, against the top, at the outer and inner diameters of the frame. The flannel detains the flour-dust, but allows the warm air and vapor to pass. The dust gathers on the cloth, and is removed by occasionally striking the pin *l*, which causes it to drop, and go out with the chop. The valve *r* governs the force of the

air current; *q* is a vacuum gage; *o* is a felt non-conducting lining.

The following notices may be consulted: —

With Compressor, *Marangoni* * "*Scientific Am.*," xliii. 11.
With Trocar, *Dieulafoy* . . * "*Mech. Dict.*," Fig. 6665, p. 2629.

By Flow of Hydrant Water.
Richards . . . . . * "*Scientific Am. Sup.*," 808.
For Laboratories, *Hanks* . . * "*Scientific Am. Sup.*," 101.

As-say'. (*Mining.*) To test ores by chemical or blow-pipe examination.

Assaying Outfit . * "*Eng. and Min. Journal*," xxv. 443.
Assay Office Model "*Scientific American Supplement*," 211.

UNITED STATES PATENTS.

181,304, *Berge* . . . . . Furnace and Muffle.
94,508, *Phillips* . . . . Automatic Assay Apparatus.
227,852, *Snow and Seamans* Burner for Crucible Furnace.
220,895, *Wight* . . . . . Cupel Furnace.

Consult: —

Lieber's "*Assayers' Guide.*"
Mitchell's "*Manual of Practical Assaying.*" London, 1868.
Bodemann and Kerl's "*Treatise on Assaying*" (Transl.). New York, 1865.
Budge's "*Practical Miners' Guide.*" London, 1866.
Byland's "*Assay of Gold and Silver Wares.*"
Kerl's "*Practical Treatise on Metallurgy.*"
Overman's "*Practical Mineralogy, Assaying and Mining.*" Philadelphia, 1868.
North's "*Practical Assayer.*" London, 1874.
Rickett's "*Mints and Assay Offices of Europe.*"
Knapp's "*Chemical Technology.*"

As-sem'bling. For account of the parts and methods used in the manufacture of fire-arms on this principle, see RIFLE.

As-tat'ic Gal'va-nom'e-ter. One the magnetized needle of which is balanced so as to make it normally quiescent in any position.

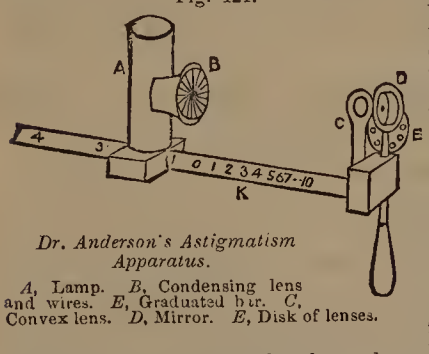
"*Manufacturer and Builder*," * xi. 276.

A-stig'ma-tism Ap'pa-ra'tus.

"Astigmatism is that condition of the eye in which the refraction is different in different meridians of the eye, owing to the refractive media not being perfectly symmetrical. An eye with a cornea shaped like the bowl of a spoon, instead of like a portion of a sphere, would be astigmatic. Dr. Anderson's instrument was exhibited at the meeting of the British Association at Swansea. In it the observations and measurements are made by the observer, and are entirely independent of the patient's sensations. The image thrown on the retina being used as an object, the error arising from the vessels or optic nerve being before or behind the retina is avoided. The refraction and accommodation of the observer does not affect the result: it is only necessary that he should be able to see whether certain lines are sharply defined.

"A lamp (*A*, in the engraving) is provided with a condensing lens, which has a screen of radiating wires, *B*, across its front, thus giving a bright field with black lines. This slides on a graduated bar, *K*, at the other end of which is a convex lens, *C*. It is better to have two of these of different powers, *4* and *10* dioptrics being convenient. Close to the lens, and at an angle of 45° to it, is a plane silvered mirror *D*, which reflects the rays at right angles to their former path. The instrument is held so that this pencil of rays enters the observed eye and when the screen is at the proper distance an image of it is formed on the retina. The mirror has its center left unsilvered, and has an ordinary disk of lenses, *E*, behind it to render the retina and the image on it visible to the observer by the ordinary direct method. The bar is so graduated that when an image of the whole or part of the screen is sharp on the retina, the figure opposite the screen expresses the refractive error of the meridian by which the image is produced. Hence, if the image of the whole screen is seen to be equally sharp, the eye is known to be not astigmatic, and the graduation gives the number of dioptrics by which it is myopic or hypermetropic. If the lines be not all sharp at once, then the most distant point at which any of them is distinct gives the refraction of the meridian of minimum refraction, and the point at which that at right angles to the former is distinct, gives that of maximum refraction. The least of these gives the spherical element of the correcting spectacle required, and their difference that of the cylindrical element. The meridian of maximum refraction is that in which the line appears distinct when the screen is at the greatest distance. If the cylindrical lens be convex its axis must be in this meridian; if concave, then at right angles to it. The makers are Cook & Sons, York. — *Lancet.*

Fig. 124.



Dr. Anderson's Astigmatism Apparatus.

A, Lamp. *B*, Condensing lens and wires. *E*, Graduated bar. *C*, Convex lens. *D*, Mirror. *E*, Disk of lenses.

The ametrometer is also capable of being used to detect the existence or extent of astigmatism. See AMETROMETER, pp. 28, 29.

Referring to the ametrometer, it may be stated that when astigmatism is suspected, the patient should be directed to observe whether the flames are longer in one direction than the other, and if so, by the rotation of the bar on a pivot opposite to the fixed light, the two lights being placed some distance apart so that they do not appear to touch, the apparatus affords one of the most accurate means of ascertaining the meridians of greatest and least refraction, since it will become easy for the patient to say when two elongated points or ovals of light are placed so as to have the same direction; and when this has been fixed, the pointer on the instrument will indicate on the half-circle the exact angle at which the lights are placed, and hence the position of the meridian of greatest ametropia.

Fig. 125.

Astrolabe of Sir Francis Drake.

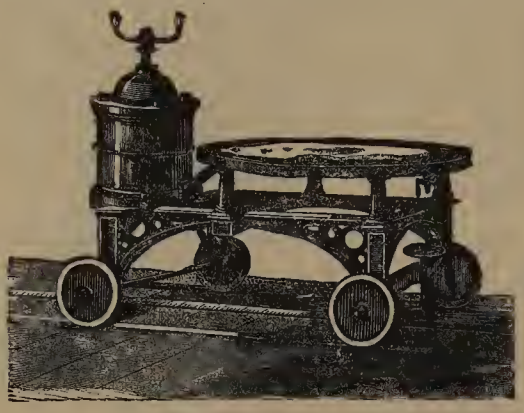
On bringing the flames into contact at this angle, the real distance of the lights apart will indicate the degree of ametropia, and having thus found one meridian, the lights can be placed at right angles to it, and the refraction of the second be ascertained.

As'tro-labe. Several astrolabes of antiquity, and of the fifteenth and sixteenth centuries, are referred to on p. 172, "*Mech. Dict.*" The astrolabe of Sir Francis Drake is shown in Fig. 125. It was recently shown at a loan collection. It was constructed for him previous to his first expedition to the West Indies, in 1570, and was preserved in the Stanhope family till 1783, when it was presented to the Duke of Clarence, who, in 1833, deposited it in Greenwich Hospital. It is about 9″ high.

As'tro-nom'i-cal Mir'ror. An instrument devised by M. Collin to obtain a fresh reflecting surface of mercury to reflect the image of stars under observation. To obviate the necessity of removing the film from the surface of the mercury, the metal becomes cleaned during its escape from the reservoir in which it is kept hermetically inclosed. It is thus always pure and brilliant. The reservoir shown on the left is a pump cylinder, in which a piston is operated by means of the screw represented above. This forces the metal out upon a large circular shallow vessel through a connecting tube. In order to operate the apparatus conven-

iently, it is mounted on a carriage on rails. Between the latter is a graduated scale, so that the mirror can be readjusted at any desired point. The vertical screw shown on the right serves to fix it in place.

Fig. 126.



Astronomical Mirror.

As'tro-nom'i-cal Time Mark'er. An instrument for indicating fractions of a second by means of a sliding vernier attached to a graduated scale, which it traverses second by second. A species of metronome.

Invented by E. K. Horn, and shown in the "*Engineer*," 1876. Reproduced in "*Scientific American Supplement*," * 204.

As'tro-pho-tom'e-ter. An instrument designed by Zollner to measure the *brightness* of the stars by comparing them with an artificial star of standard brightness.

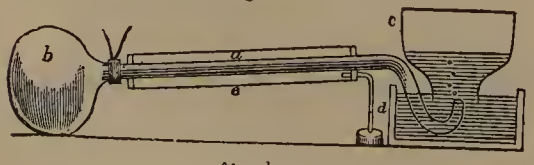
"The telescope is directed to the natural star, and the light of the artificial star is introduced through a lateral tube. A petroleum lamp serves for this object, the lateral tube carrying a diaphragm with a minute perforation in the center. In the interior of the principal tube, a plane glass mirror with parallel surfaces, placed at an angle of forty-five degrees, reflects the light of the artificial star to the eye; and as the mirror has a sensible thickness, two images are perceived with a small space intervening between them. The image of the natural star is brought to occupy this intermediate space. The lateral tube contains a polarization apparatus, by means of which the light of the artificial star may be modified both for color and for brilliancy. The first adjustment is for color. By rotating the polarization system the tint which corresponds to that of the real star observed is easily obtained, as in the saccharimeter. Then by turning one of the prisms of the system, the brightness of the artificial star, which is always at first superior to that of the real object, is gradually subdued until the two intensities are sensibly equal. As the image reflected from the first surface of the mirror is necessarily the brighter of the two, this one is selected as the standard of comparison. The other serves as a lower limit, and between the two the determination can be very accurately made." — *Barnard.*

Ath'a-nor. The alchemist's base-burning furnace. It is described on p. 175, "*Mech. Dict.*," and is to be found in —

Hebert's "*Engineer's Encyclopedia*," London, 1850, vol. i., p. 109.
Francis's "*Dictionary of Arts.*"
Partington's "*Dictionary*," 2 vols.
Weale's "*Dictionary of Terms in Art.*"

At'mo-ly'zer. (*Gas.*) An instrument for illustratiug the separation of gases.

Fig. 127.



Atmolyzer.

In the figure, the bag of impure gases communicates by a porous earthen pipe with the recciver. The pipe has an envolving sheath, the interior of which connects with an aspirator, so that a partial vacuum is maintained around the porous pipe. Gases ejected by the bag are separated by the passage of the lighter gas through the pores of the pipe to the aspirator.

At'mos-pher'ic Brake. (*Railway.*) A brake operated by pressure of air; an air brake. The term is properly applied to that form of air-brake in which, the air being exhausted, the pressure of the atmosphere becomes the moving agent. A *vacuum brake.*

At'mos-pher'ic En'gine. The engine of Newcomen, Fig. 5658, p. 2337, "*Mech. Dict.*"

See, also, Air Engine; Caloric Engine; Compressed-air Engine; Hot-air Engine, etc.

Atmospheric Engine, Br.
Newcomen (1712) . . . . * "*Engineer*," xlviii. 400.
Coalbrookdale (1776) . . . * "*Engineer*," xlix. 84.

At'mos-pher'ic Gas'-en'gine. A name given in England to the Otto and Langen gas engine, in which coal-gas is exploded in atmospheric air in a cylinder. See Gas Engine.

At'mos-pher'ic Ham'mer. A power hammer driven by the force of compressed air.

Butterfield's "*Scientific American Supplement*," * 689.

At'mos-pher'ic Re-cor'der. An apparatus for registering the various meteorological phenomena. The force and direction of the wind, the height of the baromcter, the temperature, amount of rain-fall, humidity and electrical condition of the air, are all recorded upon an endless paper band, moved by clock-work mechanism.

See Anemometrograph, Meteorograph.

At'om-i-zer. Fig. 128 shows a number of atomizers all involving the same principle, the spraying of a fluid by a blast of air or steam.

Atomizer and Volatilizer.
Wells and Duluce,* '*Journal Materia Medica*," Feb., 1877.
Antiseptic Atomizer.
Hanks . . . . "*Medical Record*," January 13, 1877.
Atomizer and Eye Douche.
Burrall . . . . "*Medical Record*," August 25, 1877.

At-tri'tion Mill. One operating by impact and mutual attrition of the material under treatment. A flouring mill in New York working on this principle has a wheel of some 3′ in diameter and 3″ thick, inclosed in a box of about 4′ in diameter and 8″ thick. The wheel makes 2,000 revolutions per minute, receives the wheat in its center, and whirls it around with such violence that by rolling friction against the sides, but especially by mutual friction or attrition, it becomes pulverized.

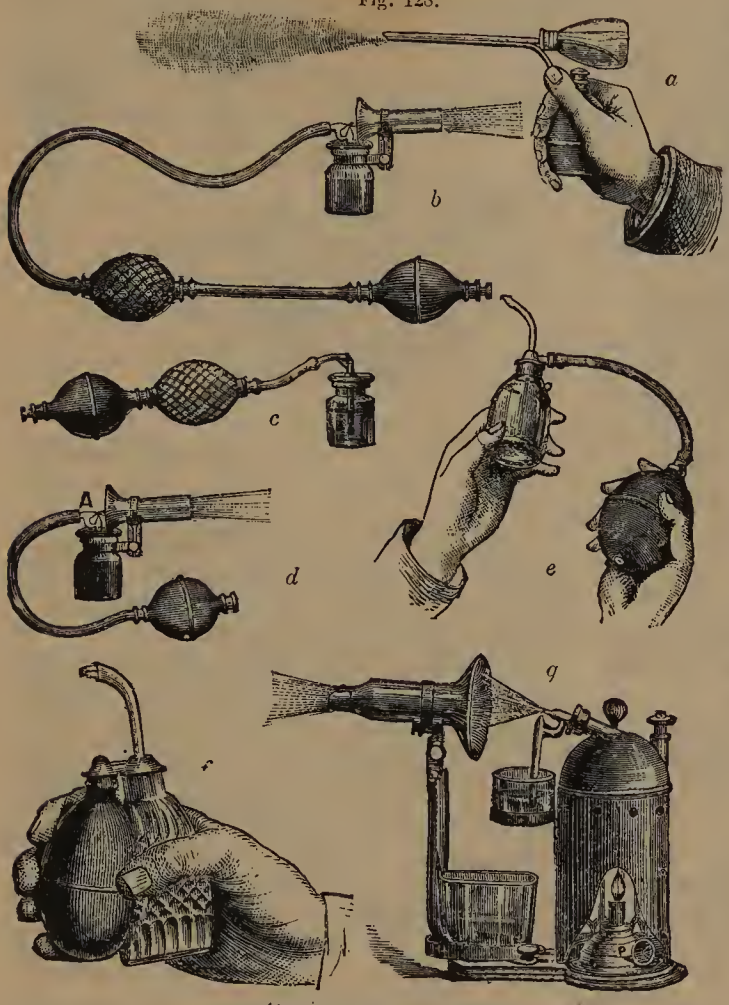
A *disintegrator.* See Fig. 1565, p. 707, "*Mech. Dict.*" Cited in "*Manufacturer and Builder*," May, 1877.

At'wood Steel. (*Metallurgy.*) Steel made by a process in which iodide of potassium is used to take up the phosphorus existing in the iron.

Van Nostrand's "*Engineering Magazine*," xvi. 280.

Au'di-om'e-ter. An instrument invented by Professor Hughes. It is a combination of the telephone, a new form of microphonic key, and a Leclanché battery. By its means the power of hearing sounds can be accurately gaged and recorded on a suitable arbitrary scale. The one in use is divided into 200 degrees, the zero being the point of positive silence, the absence of recognizable sound produced by the instrument through the telephone, and the maximum being audible to every one not actually deaf. The first point ob-

Fig. 128.



Atomizers.

a. Dr. *Knight's* atomizer. The vial is connected with the tube by a metallic cup, which is screwed on, and may be so turned as to nearly exclude air and render the spray exceedingly fine.
b. Dr. *Clark's* atomizer, with the addition of a shield.
c. The "Constant" atomizer.
d. The Boston atomizer, with single bulb.
e, *f*. Other forms.
g. Steam atomizer. It has a brass boiler, steam outlet tube, rubber packing, through which the atomizing tube passes; a safety valve; a suspended medicine-cup; a flaring face shield, and the waste cup to catch the drops.

served with the instrument is that the power of hearing sound is very sharply defined. The sound is abruptly lost within a range of one hundredth part of the entire scale, both when the person can hear audibly and when he is more or less deaf. If the sound be suddenly moved from 15° to 5° on the scale, the weaker sound is inaudible, though if the scale had been gradually moved the sound at 5° would have been easily heard. Filling the chest and holding the breath increases the capacity for hearing for a few seconds. Holding the breath with the chest not full does not produce the same result. Most persons hear better with the right ear than with the left, but physicians who have accustomed themselves to use the stethoscope with the left ear hear better with it than with the right; and four persons who habitually listened to public discourses from the left side also heard better with the left ear. See also SPHYGMOPHONE.

"*Telegraphic Journal*" . . . . . vii. 213.
"*Scientific American Sup.*" . . . 2960.

Au'di-phone. An instrument accredited to R. S. Rhodes, of Chicago, for conveying sound through the medium of the teeth.

The instrument is simply a thin plate of vulcanized rubber shaped like a Japanese fan. When in use, it is curved to give it the requisite tension by means of cords attached to the outer edge of the fan and fastened at the junction of the handle. When the top of the fan is placed against the upper teeth the impinging sound waves create a sensible vibration which is conveyed through the teeth and the bones of the face (or possibly by the dental nerves) to the auditory nerve. With a little practice, the sounds thus received are interpreted the same as if they reached the nerves of hearing through the ear; and thus the deaf are made to hear more or less distinctly, provided, of course, that the auditory nerve itself is not defective.

Newspapers, pamphlets, card-board, answer the same purpose in certain degrees.

A rod of wood, with its ends placed against the teeth or bony structure of the heads of the speaker and hearer respectively, has been used, and is a natural suggestion from Wheatstone's contrivance, mentioned on p. 2515, "*Mech. Dict.*"

The writer recollects as a boy, trading two pocket musical boxes to an old and deaf naval officer, turned portrait-painter, and watching the pleasure he derived from hearing them play when placed against his teeth.

Resting the head against the piano or harpsichord is as old as the instruments.

The head of the violinist, or of the harper, resting against his instrument, conveys the musical vibration through the bony structure to the brain. The old Egyptian who swept the strings of his standing harp in the time of Rameses the Great, laid his head against the instrument, as the paintings discovered by Bruce clearly show. See *c*, Fig. 2404, "*Mech. Dict.*"

"*Scientific American*" . xli. 342, 377; xlii. 240.
"*Sc. Am. Supplement*" . 2081, 3887.
"*Min. and Sc. Press*" . xl. 151, 172.
"*Eng. and Min. Journal*" xxix. 67.
"*Manufac. and Builder*" xii. 7, 125.
"*Iron Age*" . . . . . xxiv. Nov. 27, p. 1; xxvi. Jan. 22, p. 5; April 22, p. 16.

Au'ral In'stru-ments. (*Surgical.*) These include those for exploration, diagnosis, prothesis, operation: for the external meatus, the membrana tympani, the Eustachian canal. The list includes the following: —

Air bag.
Angular forceps.
Basin.
Bistoury.
Catheter.
Catheter holder.
Caustic holder.
Conversation tube.
Cotton holder.
Curette.
Diagnostic tube.
Director.
Douche.
Drill.
Eustachian canal inflator.
Explorer.
Eyelet forceps.
Forceps.
Furuncle knife.
Gorgeret.
Gouge.
Hook.
Inhaler.
Manometer.
Maryngotome.
Mastoid process knife.
Meatus knife.
Mirror.
Otoscope.
Polypus forceps.
Polypus knife.
Polypus snare.

Port-acid glass.	Spout.
Probe.	Spray apparatus.
Rongeur.	Syringe.
Scissors.	Tensor-tympani instrument.
Seoop.	Trumpet.
Serew hook.	Tuning fork.
Speculum.	Tympanum, artificial.
Spoon.	Tympanum, perforator.

Au-rif'e-rous. (*Mining.*) Containing gold.

Au-ro'ra Tube. A tube, of uranium glass preferably, through which discharges from an induction coil are transmitted to produce the optical effect of aurora.

Au'ro-type. (*Photography.*) Hunt's process upon paper, produced by a preparation of gold.

Aus'cul-ta'tor. (*Surgical.*) An instrument for diagnosis of diseases of the chest by listening to the sounds within the thorax. The *stethoscope* is the principal instrument; see STETHOSCOPE. The word is from the act of listening, but the diagnosis by *pleximeter* and *percussor* is not held to be strictly within the term.

Camann's cylindrical and intercostal auscultators, Figs. 254, 255, p. 82, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Aus-tra'li-an Crape. (*Fabric.*) A cotton and wool French goods.

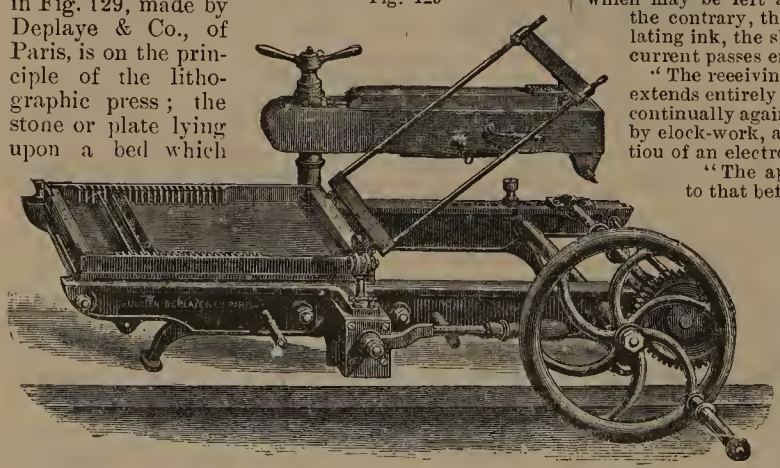
Au-tog'e-nous Sol'der-ing. Soldering by melting the adjacent surfaces of the material itself, without the intervention of solder.

The application of autogenous soldering to the making of perfect platinum stills for sulphuric acid, by Johnson, Matthey & Co , of London, is described in Professor Jenkins' Report on Chemical Industries, "*Paris Exposition* (1878) *Reports*," vol. iv., p. 65.

Au'to-graph'ic Press. A press for making copies of autographic documents, letters, etc., either upon stone or a bichromated gelatine pad.

The form shown in Fig. 129, made by Deplaye & Co., of Paris, is on the principle of the lithographic press; the stone or plate lying upon a bed which

Fig. 129



Autographic Press.

travels beneath a pressure bar, the latter being shown in the cut as detached and swung aside.

The press is intended for lithography and chromolithography, as well as phototypy, and some other gelatine processes of reproduction.

Au'to-graph'ic Pro'cess. A mode by which a manuscript or drawing made with a peculiar ink may be transferred to stone and then printed.

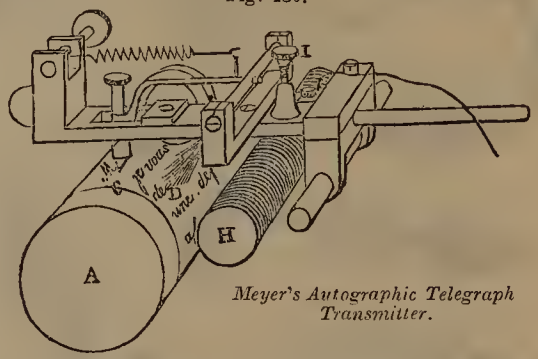
The definition may be somewhat extended, now that a variety of processes operating with gelatine, with gelatine films, bichromated gelatine, etc., have been devised. As mechanical copying processes, the HECTOGRAPH, COPYGRAPH, etc., are familiar.

Two autographic litho-processes may be mentioned: —

Hannot, Belgium . "*Scientific American*," xxxvii. 259.
Sars, Norway . . . "*Scientific American*," xxxvii. 326.

Au'to-graph'ic Tel'e-graph. The *Meyer* apparatus has substituted the Caselli on the French lines served by that form of apparatus. The Caselli system is described on p. 191, "*Mech. Dict.*"

Fig. 130.



Meyer's Autographic Telegraph Transmitter.

"In the Meyer instrument the sending-cylinder *A* is insulated, and upon it is wound the message written with an insulating ink upon a sheet of metallic paper. An endless screw, *H*, is moved by clock-work, and carries a car armed with a brush of metallic wires, *D*, and a metallic point, *C*. The brush and point are insulated from each other, and rub constantly against the surface of the paper.

"For each turn of the cylinder *A*, the car moves forward one thread of the screw, or a distance of ¼ millimeter, so that each point of the surface of the cylinder is brought successively in contact with the point *C*. This point is connected permanently with the ground.

"At the transmitting station, the positive pole of the battery is connected constantly on the one hand with the brush *D*, and on the other with the line-wire. The battery is therefore continually in action, but the distribution of its current depends upon the position of the stylus *C*. When the latter touches the metallic surface of the paper, the circuit is closed by the way of the brush *D*, the paper, the stylus, and the ground. Almost the entire current passes into this short circuit, and the line receives only a small portion, which may be left altogether out of account. When, on the contrary, the stylus *C* touches a part of the insulating ink, the short circuit is broken, and the battery current passes entirely over the line.

"The receiving cylinder carries a spiral thread which extends entirely around the cylinder. This thread rubs continually against an ink-roller. The paper is unrolled by clock-work, and brought up to the spiral by the action of an electro-magnet.

"The apparatus for synchronism is also similar to that before described.

"If the circuit is closed and the paper is brought in contact with the spiral during a whole turn of the latter, a straight line is drawn across it; at the commencement of another turn a new line is begun, and so on. It will thus be seen that whenever the transmitting stylus touches the ink, permitting a current to pass over the line, the paper receives an impression corresponding to the length of the emission. The writing on the metallic paper is thus reproduced at the receiving end." — *Lines.*

See "*Report on Vienna Exposition*," vol. ii., Section I., pp. 37, 40.

D'Arlincourt's automatic telegraph is described in Lines' "*Report on Vienna Exposition*," vol. ii., Section I., * p. 40.

"*Telegraphic Journal*" . . . . * vi. 495.
* vii. 28.
"*Scientific American Supplement*" * 2433, * 2645.

Sawyer's autographic telegraph, or *Pantelegraph*, is described in "*Telegrapher*," * 1876. Reproduced in "*Scientific American Supplement*," * 302.

Au'to-in-suf-fla'tor. An instrument for the self-administration of medicine in the form of powder. Figure 131.

Au'to-ki-net'ic Tel'e-graph. (*Electricity.*) An English name for a form of municipal telegraph for fire-alarms, police, etc.

See "*Teleg. Journal*" . . . . * iv. 241.
"*Engineering*" . . . . . * xxiii. 402.

Au'to-la-ryn'go-scope. An instrument by which one may inspect his own larynx. See *"Treatise on the Laryngoscope,"* by Dr. Sieveking, *"Lancet,"* April 8, 1865, p. 360.

Fig. 131.

Dr. Bridge's Auto-insufflator.

Au'to-mat'ic Air'-brake. (*Railway.*) *Westinghouse.* The air is compressed by a steam-pump on the engine, and is stored in tanks on the engine, and under the tender and cars, connection being made by pipes and flexible hose.

"When the brakes are to be applied, compressed air is admitted from the tank on the engine to a valve called a *triple valve* under each car, which releases the compressed air stored up in the tank under that car and admits it to a cylinder provided with a piston which is connected with a system of brake-levers, and the pressure of the air is thus transmitted to the brake-shoes. In this brake the air for operating the brakes on each car is stored up in a tank on that car, whereas in other systems of air-brakes the compressed air to operate the pistons under each car must all flow from the tank on the engine, and in vacuum-brakes the air from the appliances on the car used to operate the brakes must flow forward to the engine before the brakes can be applied. This consumes an appreciable amount of time, whereas the application of the automatic brake is almost instantaneous. The triple-valve is so arranged that the brakes can be applied from each car by pulling a cord, and they will also be applied to the rear part of a train in case it should break in two parts, if one or more cars should be separated from the rest of the train." — *Forney.*

See Figs. 655–745, "*Car-Builders' Dictionary.*"
"*Engineering,*" * xxv. 203.

Au'to-mat'ic Bor'ing Tool. An instrument on the principle of what is known as the Persian drill. See Fig. 3650, p. 1671, "*Mech. Dict.*"

Fig. 132.

Automatic Boring Tool.

A spiral on the stem is rotated by endwise pressure on the handle, and when the pressure is withdrawn the case is restored by a spring to its former position. Used for small drilling, such as dentists' and jewelers' work, etc.

Au'to-mat'ic Car'-brake. See RAILWAY CAR-BRAKE.

Au'to-mat'ic Clock. One that will continually or recurrently wind itself. Such have frequently been suggested. Two are mentioned on p. 576, "*Mech. Dict.*" Another is described in the "*Journal of German Engineers,*" as the invention of F. Hellig.

The power winding it up is change of temperature, which expands or contracts glycerine contained in a cylinder and supporting a piston; the piston-rod is connected by means of a toothed rack to ratchet wheels, so arranged that the motion of the piston will wind up the clock whether this motion is upward or downward. The clock may have a weight or a spring. It is evident that such a clock must not be placed in a room where the temperature is equal, but will act best when exposed to extremes, such as are found on the top of meteorological observatories, for which the inventor especially recommends it.

Au'to-mat'ic Cut'-off En'gine. One self-operating, cutting off steam at such portion of the stroke as shall maintain a regular rate of motion. The cut-off device is usually operated through the governor. See CUT-OFF.

Au'to-mat'ic Print'ing Tel'e-graph. An instrument or system which transmits a message, previously prepared, on a paper strip, which is simply drawn through the instrument. The message is usually punched in the strip, the dots or dashes signifying letters.

It is used in connection with a *printer*, which, in ordinary cases, is a puncher.

*Edison's, Phelps', Meyer's,** described by Lines, in his "*Report from the Vienna Exposition,*" 1873, p. 37 *et seq.*

Little's Automatic Telegraph, * *Lines'* "*Report on Vienna Exposition*" of 1873, vol. ii., Section I.

Au'to-mat'ic Re-peat'er. (*Electricity.*) One which is thrown into action by the current itself.

Au'to-mat'ic Sig'nal Tel'e-graph. One set in action by an original impulse derived from —

A thermostat, in case of fire.

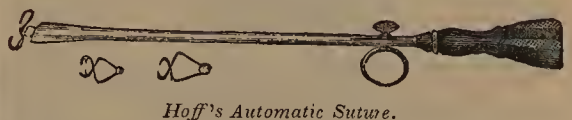
Tampering with a safe, for instance, by a robber.

The turning of a handle, as that of a fire-alarm box, etc.

Au'to-mat'ic Steam En'gine. One having a cut-off self-adjusted from the governor. See CUT-OFF.

Au'to-mat'ic Su'ture. A spring claw, for

Fig. 133.



Hoff's Automatic Suture.

holding together the lips of a wound. Used in vesico-vaginal operations, etc. The clasp is held on the end of an applicator, and thus applied, a slide pin releases it, and it is then self-holding.

Au'to-mat'ic Switch. 1. (*Electricity.*) A device used in many forms of electric apparatus to turn the current in another direction, to reverse it, etc.

An automatic device, to reverse the current in the electric candle of the Jablochkoff light. See "*Scientific American Sup.,*" * 2574.

2. (*Railways.*) A self-setting switch, or one operated by agencies set in motion by the train, for instance.

Au'to-mat'ic Ven'ti-la'tor. (*Railway.*) A car ventilator arranged so as to be self-adjusted, according to the direction in which the car is moving.

Au-tom'a-ton.

"Psycho," Eng. .	* "*Scientific American Sup.,*" 1684.
	"*Scientific American,*" xxxiv. 342
	"*Iron Age,*" xix., June 28, p. 24.
Cornet Player, etc.	"*Scientific American Sup.,*" 2482
Houdin's, etc. . .	"*Iron Age,*" xxvii., April 6, p. 7.

Au'to-oph-thal'mo-scope. An instrument by which one may inspect the interior of his own eye. Fig. 3403, p. 1563, "*Mech. Dict.*"

See "*Treatise on the Use of the Ophthalmoscope,*" by Dr. Hutchinson, "*Clinical Reports of the London Hospital,*" 1867, 1868, p. 182.

Au'to-phone. An accordeon or organ, in which a music-sheet of Bristol board, perforated for the notes, is passed through the instrument; the notes sounded are as air passing through the respective perforations is admitted to the appropriate reeds or pipes.

Invented by Merritt Gally. See —

"*Manufac. and Builder*" * xi. 124.
"*Scientific American*" . * xl. 351; xli. 342.

Au'to-pol'y-graph. An autographic printing process. See *Hectograph*, etc.

Bauer's Process, "*English Mechanic*," xxvi. 46, 74.

A-ven'tu-rine. (*Glass.*) 1. *Aventurinus lapis.* A variety of translucent quartz or feldspar spangled throughout with scales of yellow mica. — DANA.

2. A precious quartz spangled with crystals or flakes of gold, giving it a brilliant appearance.

3. *Artificial aventurine* is an imitation of the natural, and consists of glass intermingled with little flakes of copper which look like grains of gold. — *Gold-stone.*

Menage says that the mode of making artificial aventurine being discovered by *accident* among the Murano glass-workers, the stone was called *avventurino*, that is, *pierre d'aventure*, and that this name was eventually applied to the natural stone, which the artificial gem resembles.

Artificial aventurine is made in Murano, Venice, by a secret process. It is yellow, and in the mass are to be seen imbedded numerous small brilliant crystals of copper, or, according to some chemists, of silicate of protoxide of copper. When polished, this glass affords a brilliant object for mounting by jewelers.

It is evident that the crystals are produced in the body of the glass while the latter is in a state of fusion. Among the elements which compose the glass are found the oxides of iron and tin, and M. Peligot deems it probable that it is due to the reduction of the bioxide of copper by these metals that the production of the crystals of copper is to be attributed.

M. Hautefeuille has made aventurine, the recipe for the ingredients being as follows: —

Glass (St. Gobain)	2,000 gr.
Nitre	200 gr.
Flakes of copper	125 gr.
Peroxide of iron	60 gr.

When the glass is completely melted, and while yet in the crucible, add 86 gr. of fine iron turnings wrapped in paper, and mix by means of a red-hot iron rod. The glass becomes blood-colored, opaque, and at the same time doughy and bubbly. Stop the draft of the furnace, put the cover on the crucible and cover with cinders; allow the furnace and crucible to cool very slowly. The following day break the crucible and the glass will be found permeated with crystals, regularly disseminated in parts, in others stratified and irregular, according to the success in mixing the materials.

It has been suggested to add the filings to the pounded glass or frit, in order to obtain more complete dissemination.

Green aventurine or *aventurine de chrome*, as termed by its inventor, M. Pelouze, is compounded of the following: —

Sand	250 gr.
Carbonate of soda	100 gr.
Carbonate of lime	50 gr.
Bichromate of potassa	40 gr.

The glass which results from this combination contains from 6 to 7 per cent. of oxide of chrome, of which about half is combined with the glass, and the remainder assumes the form of brilliant crystals or flakes.

The color of the *aventurine de chrome* is that of the third yellow-green, the thirteenth tone in the chromatic circle of M. Chevreul. It is very brilliant and its radiant power is stated by M. Pelouze to be second to the diamond only. It is harder than window glass, which it cuts easily, and is much harder than the aventurine of Venice.

Awl Clip. A board and clip pin, to hold blanks, message, or memorandum paper, etc. The pin penetrates the pile of papers, which are removed from time to time with a slight tear in the edge.

Fig. 134.

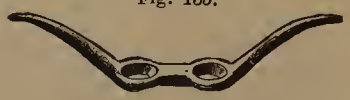
Awl Clip.

Awn'ing Block. A small wooden block for suspending or stretching an awning over the quarter-deck, or elsewhere.

Made plain or rope-strapped, and with an eye.

Awn'ing Cleat. A small becket on which to belay an awning rope.

Fig. 135.

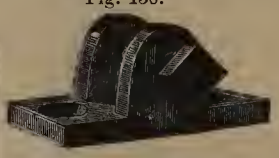


Curved Horn Awning Cleat.

Awning Hinge. One to which an awning rod is journaled. See Fig. 136.

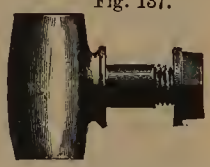
Awn'ing Slide. A holder with a tube through which the rod of the awning slides.

Fig. 136.



Awning Hinge.

Fig. 137.



Awning Slide.

Axe. The poll is formed from a solid bar of iron by a machine that operates two punches simultaneously to form the eye for the reception of the handle. The heated bar is placed under shears that cut off a piece sufficient for the poll, which piece is placed in the machine, the two punches working from either edge, a supplementary punch finishing the eye and a set of dies forming the sides, when the poll drops, still red hot, ready to receive the bit. The after insertion of the steel bit and shaping the axe are done by ordinary forging.

The axes are then sent to the hardening and tempering room, which is partially darkened. The hardening ovens are circular, having a vertical shaft in the center to which are attached rotating tables, on which the axes are laid with the bits toward the outside. The table turns slowly but continually, bringing the axes over furnaces of anthracite coal alternating with spaces. When brought to the proper redness by heat, the axes are hung on hooks on a revolving frame, the bits dipping into a tank of brine, which is kept in constant circulation by a pump. When cool, the axes are tempered, which is done by heating them in a rotary oven like that used for the hardening, except that the fuel used is charcoal. One of the batch of perhaps 200 which are tempered, or drawn, at one time is brightened, and serves as a test of all the others, the rotary action of the shelves insuring equal heating. When the brightened axe shows the right color, the entire batch is removed, and the axes are then ready for the subsequent finishing operations of grinding and polishing.

Several kinds of axes are used among fishermen and whalemen.

Boat hatchet: For cutting the harpoon line at the bow, if it become tangled in "paying out."

Head axe: For cutting off the head of the whale; opening the skull to obtain the spermaceti; cutting off the baleen, etc.

See also SPADE.

Rollins's axe, with detachable bits, is described in "*Scientific American*," * xxxvi. 355.

(*Stone Working.*) Stone axes are of several kinds; their distinguishing peculiarity is having an edge, while the *hammer* has a *face* and a *pick* has a point.

The *cavil* has a face at one end and a point at the other.

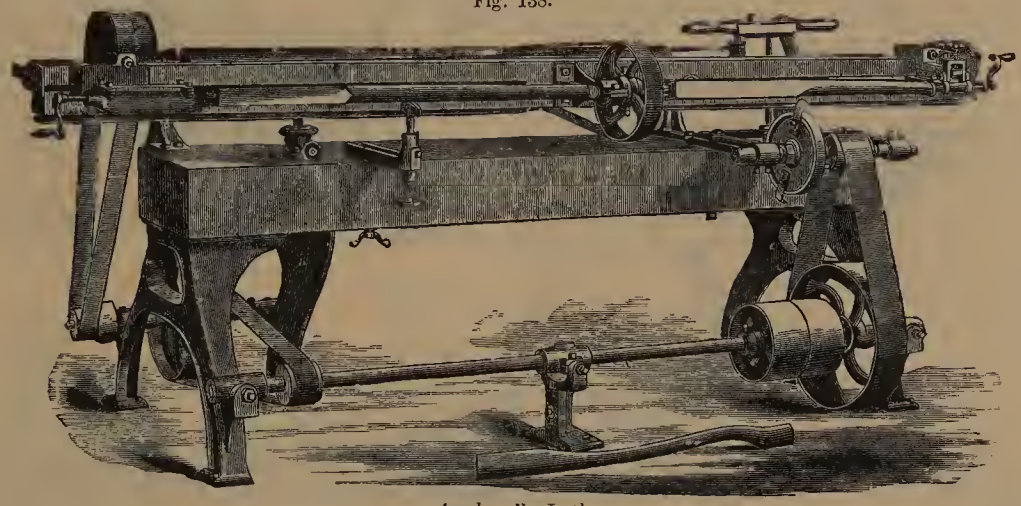
See list under HAMMERS AND STRIKING TOOLS.

Axe Wedge. A small iron wedge driven into the end of the axe-handle, within the eye, in order to expand the wood, and prevent the head flying from the helve.

Axe-han'dle Lathe. This is a machine on the Blanchard spoke-lathe principle, and is adapted to work by pattern. It is shown, Fig. 138, as making a spoke. The pattern spoke is at the left, and rotates against a guide-piece, so that the swinging frame in which the pattern spoke and the blank are chucked moves back and forth as the pattern traverses against the guide. The frame has a motion endwise, and the revolving cutter dresses the blank in accordance with the governing piece against the pattern.

It will turn out 20 to 25 dozen 3 feet axe-handles, or 150 to 300 spokes per day, according to size. The machine feeds itself after the work is in, working by a pattern, and is so arranged that the same pattern will make several sizes, and stops feeding when the end of the stick is reached by the cutter. It is also arranged with adjusting screws to level up the tilting frame for different sizes of work.

Fig. 138.



Axe-handle Lathe.

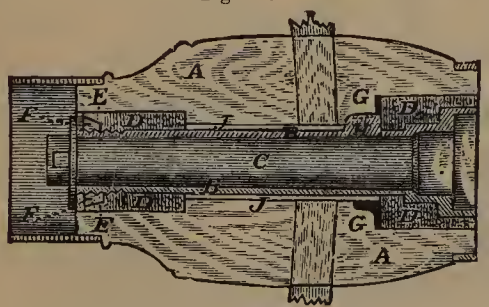
Ax-il'la Ther-mom'e-ter. A thermometer, so named from the axilla affording a convenient place for the instrument in the observation of personal temperature. See also CLINICAL THERMOMETER.

Fig. 139.

Axilla Thermometer.

Ax'le. The rubber-cushioned carriage axle is shown in the hub, Fig. 140, and detached, but with the cushions in place, in Fig. 141.

Fig. 140.



Miller's Rubber-cushioned Axle-box.

A, Hub. *B*, Axle-box. *C*, Axle arm. *D*, Rubber cushions. *E*, Compression nut. *F*, Cavities in compression nut admitting points of the wrench when compressing cushions. *G*, Slotted retaining sleeve. *H*, Spur on axle-box. *J*, Space between axle-box and hub.

It consists of a vulcanized rubber cushion in the form of a thick band interposed between the axle-box and the wood of the hub, as shown by Fig. 140, giving a sectional view of an ordinary hub, to which the cushioned axle is applied.

Adjustable axles to regulate height, are common in reapers, and their adjustment at the divider, on the grain end of the cutter bar, is one of the points of regulation in fitting the machine to cut to a certain height of stubble.

The axles of wheeled cultivators have also an

Fig. 141.

Rubber-cushioned Axle.

adjustability to raise or lower the machines, according to the required depth of tillage.

Lincoln's Patent Axle, *"*Mining & Sc. Press*," xxxviii. 289.
Axle centering machine, *"*Railroad Gazette*" xxvi. 59.

Fig. 142.

Spring and Axle Block.

Ax'le Block. A block bolted to a vehicle axle to form a seat for the spring. See Fig. 142.

Ax'le Box. (*Railway.*) A cast-iron box inclosing the end of the axle, its bearing brasses, the key or saddle, and the receptacle for grease or oil and waste.

The accompanying cut, Fig. 143, is from *Forney's "Car-builders' Dictionary"*: —

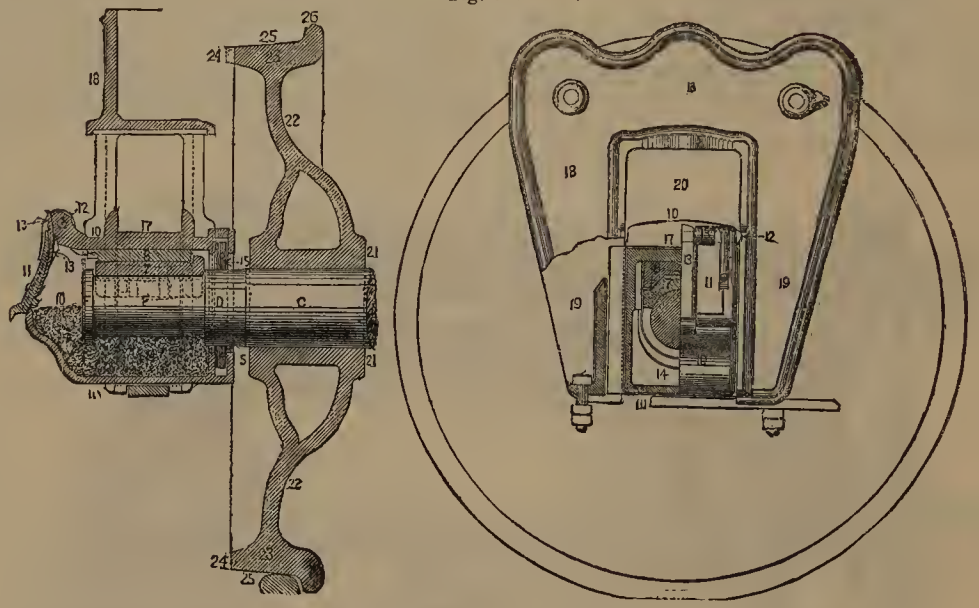
The following may be consulted: —

Axle, Austrian	*Paget, Becker,*	* "*R. R. Gaz.,*" xxii. 559.
Axle, Br.	*Attock*	* "*Engineering,*" xxix. 280.
Axle, Self-oiling,	*Tomlinson*	* "*Sc. Amer.,*" xxxvi. 54.
	Tomlinson	* "*Sc. Amer. Sup.,*" 1875.
Axle, Radial	*Windmark*	* "*Engineer,*" xliv. 333.

Ax'le Box Met'al.

Lining Metal for Axle Boxes:	Tin	24
	Copper	4
	Antimony	8
Melt and then add tin		24
		60

Fig. 143.



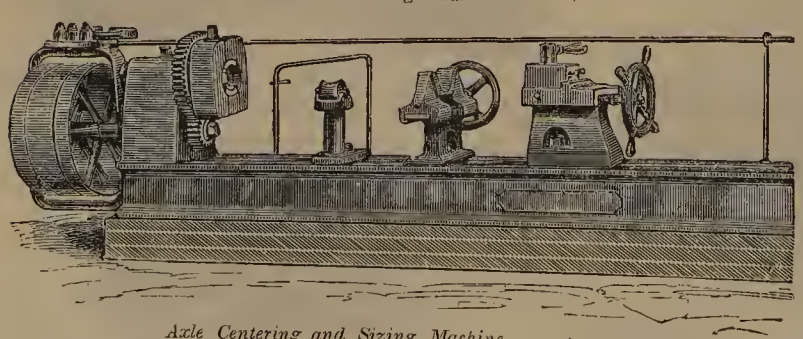
Axle, Wheel, and Axle Box.

A. Center of axle.
B. Neck of axle.
C. Wheel-seat.
D. Dust-guard bearing.
E. Journal.
F. Axle collar.
3. Stop-plate.
7. Journal bearing.
8. Journal bearing key.
9. Stop-key journal-bearing.
10. Journal box.
11. Journal-box cover.
12. Journal-box cover hinge-pin.
13. Journal-box cover spring.
14. Journal-packing.
15. Dust guard and chamber.
16. Dust collar.
17. Equalizing-bar seat.
18. Pedestal.
19. Pedestal horns.
20. Pedestal jaw.
21. Hub of wheel.
22. Wheel-plate.
23. Rim of wheel.
24. Face of rim.
25. Tread of wheel, or wheel tread.
26. Wheel-flange.
27. Journal-bearing stop-key.
28. Oil cellar.
29. Stop journal-bearing.

Ax'le Box Guides. (*Railway.*) Slips on the inner faces of the pedestals of a railway truck, to guide the axle brasses as they move up and down.

Ax'le Cen'ter-ing and Siz'ing Ma-chine. A machine tool, to be used in connection with an axle lathe, to center the rough axle, and after it has been turned to size in its journals and rough-turned in the *fit*, to finish this part accurately, and to dress off the ends as well as to re-center. This machine is provided with a powerful chuck lined with brass to clamp the axle by its outer collar. It is arranged with fast and slow motions on the driving gear.

Fig. 144.



Axle Centering and Sizing Machine.

The axle rests in an adjustable V-guide at its end farthest away from the driving head; a squaring-up tool finishes the end of the axle, and at the same time re-centers it. The *fit* part of the axle is brought to size by a hollow reamer provided with adjustable cutting blades.

Ax'le Clip. A saddle-shaped clamp which binds a spring to its axle, a spring bar to its spring, etc., etc. Various forms of axle clips are shown in Fig. 145.

Ax'le Col'lar. An enlargement on an axle to form a butting ring, that is, to receive a thrust.

The collar is ordinarily on the shoulder of the axle arm in road vehicles, but is also placed on the outer end in car axles. Examples of each are given on pp. 198–203, and Figs. 1091–1093, p. 459, "*Mech. Dict.*"

Ax'le Lathe. 1. A lathe, Fig. 146, for turning car axles. The shears or bed is in the form of a continuous cylinder of requisite strength, with flat surfaces added to the cylinder for attachment of heads and bearing of slide-rest. The live-head or driving-head is simple and powerful. The face plate is fitted with the Clement driver, which insures rotation of the axle with no lateral strain on the centers. The back-head has a very large spindle

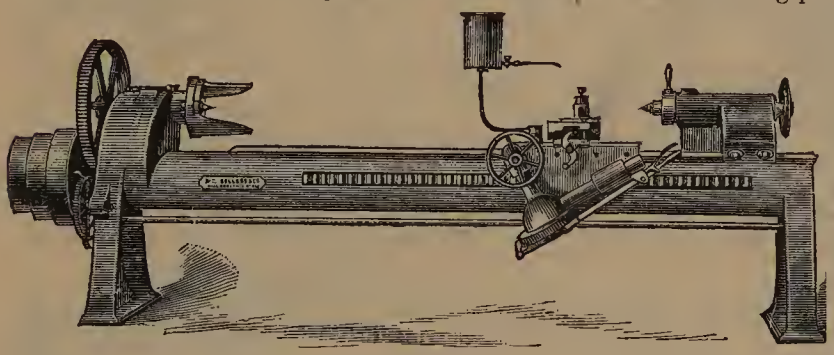
Fig. 145.

Axle Clips.

a. Flat, sharp center bent axle clip.
b. Sharp center bent axle clip for spring bars.
c. Sharp center-ribbed, bent axle clip for spring bars.
d. Sharp, wide center, ribbed, bent axle clip for spring bars.
e. Sharp center, O. G., bent axle clip for spring bars.
f. New pattern, sharp center, O. G., bent axle clip for buggy perch-plates and sleigh work.
g. Coach axle clip.

with large center, and a clamping arraugement, which insures the spiudle being held central and at the point nearest to the work. It has a rack-

Fig. 146.

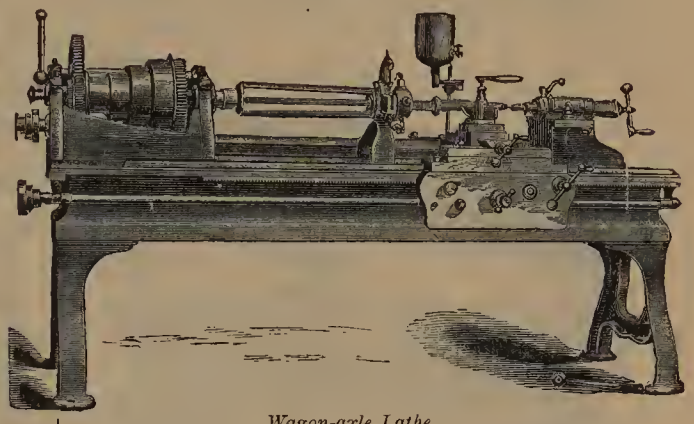


Car-axle Lathe.

feed with quick hand traverse to bottom rest; patent adjustable tool holders, automatic feed motion, which can be started instantly; rate of feed, 15 to the inch.

2. A machine, Fig. 147, for turning the spiudles of wagon and carriage axles. It swings over ways

Fig. 147.



Wagon-axle Lathe.

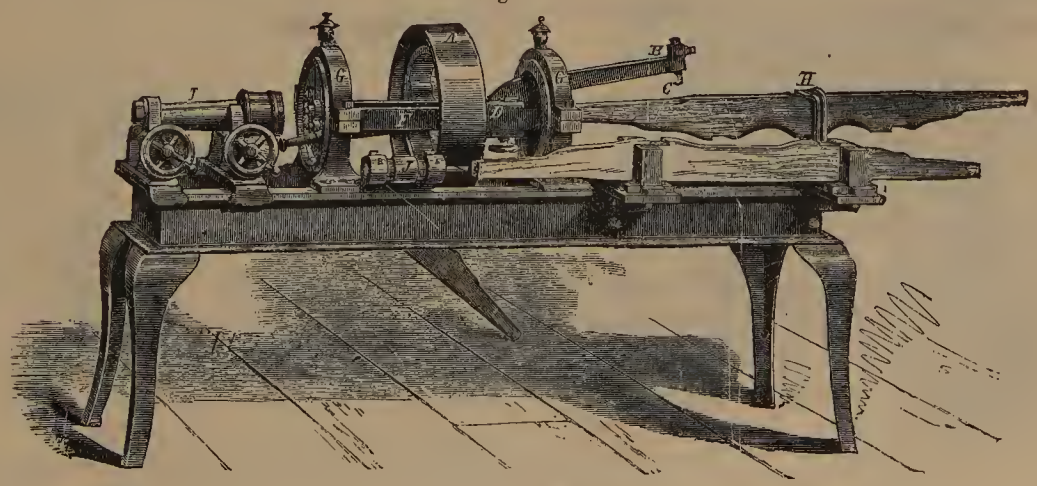
18″; the bed is 8′ long; with plain head, especially adapted for turning wagon axles, with taper attachment to carriage. This lathe can also be used for turning any regular tapers or irregular shapes, by guide or pattern, which can be fastened to a rail on back side of the bed-piece.

3. A machine for turuing spindles of woodeu axles for the reception of thimble-skeins. The machiue, Fig. 148, turns the axle to a pattern, making the wooden spindle fit any inequality in the thimble skein, filliug it throughout.

A is the driving pulley, which rotates the mechauism supporting the knife in the standard *G*. *B* is a curved cutter bar, to the outer eud of which is secured the knife *C*, and which enters the sliding block *D*, as a fulcrum. Block *D* travels in the ways *F*, and is actuated therein by the feed gearing shown at *E*. At *H* is the clamp which holds the axle while it is operated upon, and at *I* is the pattern, just below which is shown the end of the bar *B*, projecting, which, terminating in a friction roller, euters the skein, and is held against the inside surface of the same, thereby guiding the knife in its revolution, thus necessarily causing the axle to be turned to an accurate fit.

Fetu & Deliége, Liége . . * "*Engineering*," xxix. 413.
Axle-lathe Hoist. *Thomas.* * "*Railroad Gazette*," viii. 289.

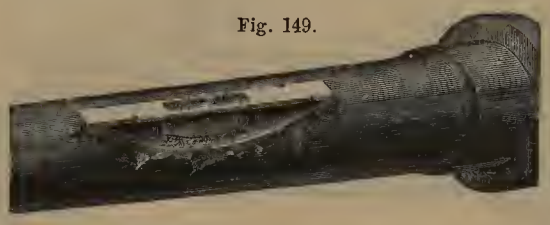
Fig. 148



Axle-turning Machine.

Ax'le Lu'bri-ca'tor. Eggleston's axle lubricator has a cap-piece inserted into the upper side

Fig. 149.



Axle Lubricator.

of the arm, and wick protruding up through it, and extending downward into an oil reservoir. See, also, AXLE-BOX, *"Mech. Dict."*

Ax'le Pack'ing. (*Railway.*) A dust guard around a car axle, to prevent access of dirt to the interior of the axle-box. Figs. 1091, 1092, p. 459, *"Mech. Dict."*

Ax'le Sad'dle. A saddle-shaped clip, for securing a spring to an axle. A plate or yoke slips over the screwed ends, and is secured by burs.

Fig. 150.

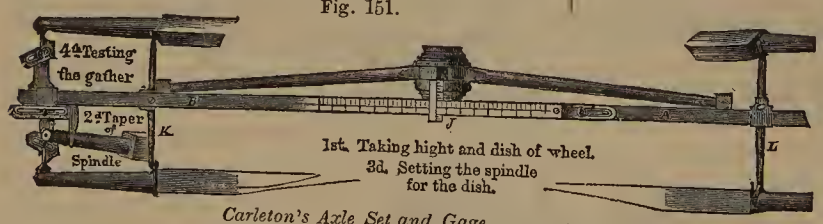
Axle Saddle.

Ax'le Seat. (*Railway.*) The opening in a wheel, fitted to receive the axle arm.

Ax'le Set and Gage. An apparatus, Fig. 151, for enabling the wheelwright to get the height and dish of wheel: the taper of spindle: to set the spindle for the dish: to obtain the gather.

The apparatus consists of a steel bar, *A*, 6′ 3″ long, and an index and gage bar, *B*, 3′ 9″ long, which slides against the former, and has a scale cut upon it to adapt the apparatus to any sized wheel. The bar *B* is attached to the main bar, 13″ from the end, by a straight standard, *K*, projecting 4″ from one edge and 3″ from the other. A screw, passing through the center of this standard, serves as a pivot for the index and gage-bar *B*. A

Fig. 151.



Carleton's Axle Set and Gage.

vertical sliding rule, *J*, on the bar *B*, is designed to show the dish, while the graduated scale on the bar shows the height of wheel. A movable arm-rest, *L*, is attached to the bar *A*, to support the gage horizontally over the center of the axle, the rest *L* and standard *K* resting on opposite shoulders of the spindles, while the taper-taker is placed over the end of the spindle to be set. The taper-taker, or graduated double caliper, is fitted with a movable arm, scale, and graduated sliding gage. It is moved on the index bar *B*, through a socket, and held in place by a set screw. The short caliper, and the short ends of standards, 3″ long each, are placed on the opposite ends of the bar *A*, on the "gather side."

Bex's axle setter, patented December 21, 1875, is for straightening bent axle arms. It is of the type of Fig. 507, p. 200, *"Mech. Dict."*

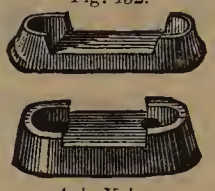
See *"Scientific American"* . . . . . * xxxv. 18.
"Mining and Scientific Press" . . . * xxiv. 289.

Ax'le Stop'-key. (*Railway.*) A plate abutting upon the end of the car-axle, to resist excessive lateral motion and take the wear.

Ax'le-turn'ing Ma-chine'.
See AXLE LATHE.

Ax'le Yoke. A plate beneath the axle; a cross-bar through which the ends of the spring saddle clip are passed, and beneath which they are secured by nuts. Fig. 152.

Fig. 152.

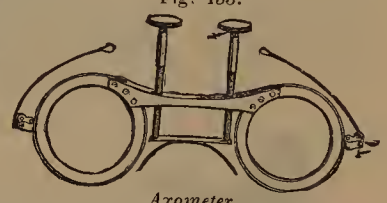


Axle Yokes.

Ax-om'e-ter. An instrument to determine the proper height of the bridge of the spectacles, in order that the lenses may be properly centered vertically with regard to the pupils. Fig. 153.

The patient having put on the spectacles, the movable bridge of the instrument is raised or lowered until the pupils are seen in the center of the circle. This done, the axometer is placed on a sheet of paper, and the bridge, along with the lower half circles, is traced thereon with a pencil.

Fig. 153.



Axometer.

Az'i-muth In'stru-ment. Sir William Thomson's instrument for taking azimuths, which he terms the "azimuth mirror," was patented Nov. 19, 1878, No. 210,068.

In it the axis, on which the mirror is pivoted, is above the plane of the lens, which is contained within the inclined tubular leg, which arrangement allows of the interval of no vision between mirror and lens to be reduced to a minimum, by reason of the inner straight edge of the mirror cutting out of sight with a sharp or fine line that portion of the lens which it hides, whereby the image of the object is seen distinctly on the degree scale of the compass-card.

The azimuth circle and azimuth compass are considered on pages 203, 204, *"Mech. Dict."* The brass azimuth of Benares, India, is shown in Fig. 571, page 204, *Ibid.* It was built by Jay-Singh, Rajah of Jayanagar, in the 17th century. The equatorial and equinoctial dials of the same holy city of the Ganges are shown on page 692, Figures 1624, 1625, *Ibid.* The subject is discussed in Dr. Hooker's *"Himalayan Journals," "Transactions American Oriental Society,"* vol. vi., Dr. Hooker's *"Notes on Bengal, Nepaul, etc."*

Az'o-tine. An explosive: Saltpeter, 69.05; carbon, 15.23; sulphur, 11.43; petroleum, 4.29 per cent.

B.

Bab'bit-ing La'dle. An iron ladle for holding and pouring the melted alloy known as babbit-metal, and used for bearings.

Ba-biche'. (*Fishing.*) Properly *barbiche.* A common name in France for the *nigelle de Damas;* called also *araignée* (spider), *barbe de capucin,* and *cheveux de Venus.* Used in net-making.

Back Band. (*Manége.*) That portion of the harness attached to the gig-saddle under the jockey, and used as a support for the shaft-tug.

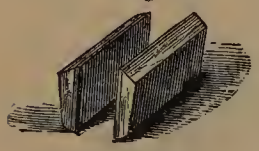
Back Board. (*Boat.*) The board across the stern-sheets of a boat for supporting the backs of the passengers.

Back Cyl'in-der-head. (*Steam.*) That head of a cylinder through which the piston-rod passes.

Back End. (*Mining.*) That part of a judd (an undermined mass of coal) which is left after the lump is brought down.

Back'ing Boards. A pair of wooden jaws, Fig. 154, to grip a book in the book-binder's vise.

Fig. 154.



Backing Boards.

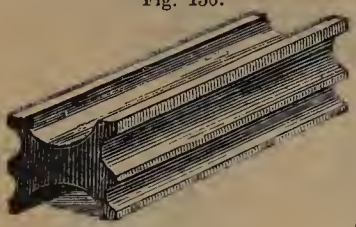
Fig 155.

Backing Hammer.

Back'ing Deals. (*Mining.*) Timbers placed behind cribs to keep back loose strata.

Back'ing Ham'mer. (*Bookbinding.*) The hammer, Fig. 155, used in beating the backs of books in condensing and rounding them.

Fig. 156.



Backing Iron.

Back'ing I'ron. (*Bookbinding.*) An appliance used in giving the rounded shape to the backs of books. On its face it has depressions of varying depth and width.

Back'ing Ma-chine'. (*Bookbinding.*) A machine used in rounding the backs of books. That shown in Fig. 160 is adapted to back blank books from $\frac{1}{4}''$ to 4″ wide, and 30″ long and under. The revolving backing-iron is hollow, and is heated from the center by gas or steam. On the right of the cylinder is the adjusting screw, and at the same end is the device which secures the cylinder on the groove desired.

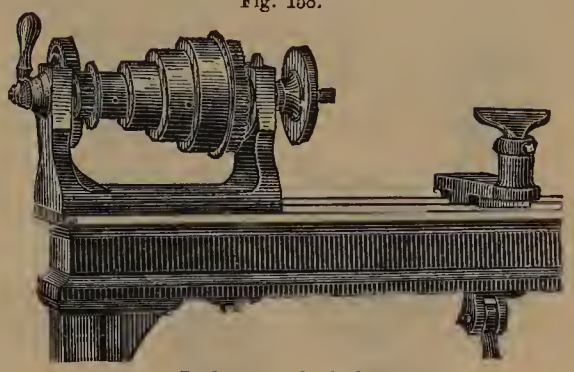
Fig. 157.

Backing Pan on Leveling Stand.

Back'ing Pan. (*Stereotyping.*) A pan, Fig. 157, in which the electrotype shell is placed, face downward, while the melted metal is poured on its back.

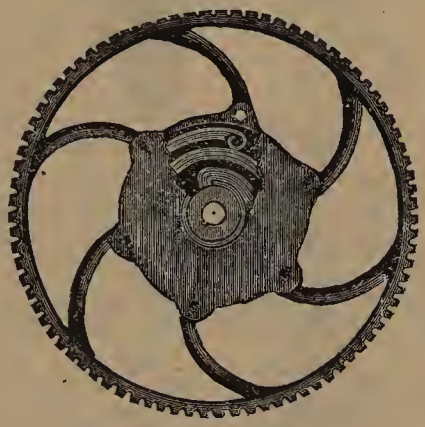
The table being perfectly level, the stand is secured to the floor by its feet. The pan is swung on to the stand, and the metal poured on to the shell, commencing at one of the corners and gradually running it over the whole until it is of sufficient thickness.

Fig. 158.



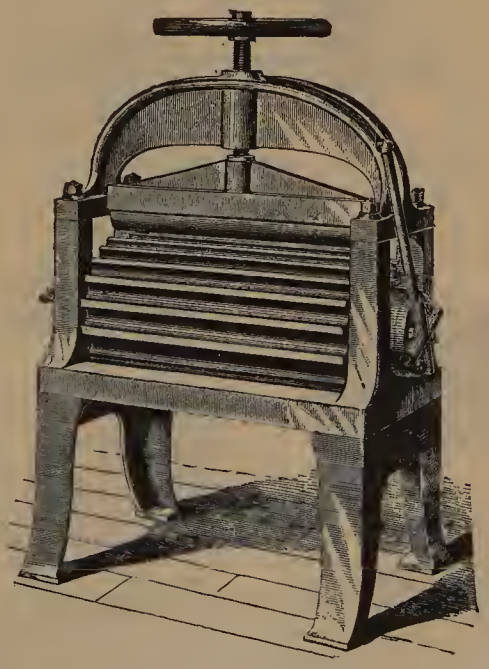
Back-geared Lathe-head.

Fig. 159.



Spur-wheel with Back-lash Spring.

Fig. 160.



Book-backing Machine.

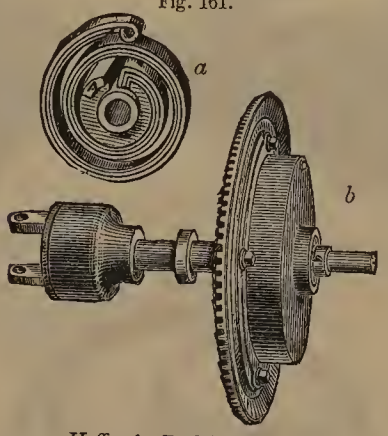
Back'-geared Lathe. One having a set of variable gears in the head-stock.

Back'-lash Spring. A spring interposed between an engine or horse-power and the machinery driven, to prevent a jerking motion in transmission. The spring is wound upon the shaft, its ends connected to the driver and driven portion respectively, so as to absorb a sudden jerk.

Fig. 159 represents the spur-wheel of a thresher, with a casing for the spring cast in its center.

Fig. 161, *a*, represents a spring and hub detached

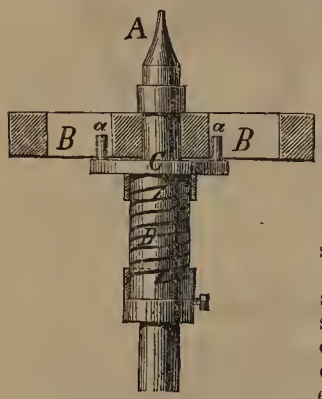
Fig. 161.



Heffner's Back-lash Springs.

from the casing. The hub is keyed to the shaft; the inner end of the spring is connected to the hub, and the outer end to the wheel. Fig. 161, *b*, is a bevel-wheel of a side-gear, forming a casing for the spring.

Fig. 162.

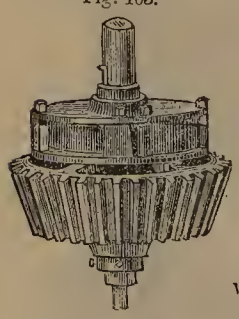


Alsop's Back-lash Spring.

Fig. 162 is Alsop's spring wound upon the shaft, and having a similar function to the above described.

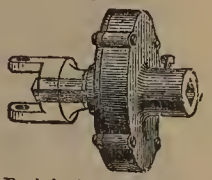
In Fig. 162, *A* is a mill-spindle; *D* the spiral spring, one end clamped to the spindle, and the other end to the driver *C*, which presses by its pins *a a* upon the spokes of the pinion *B*.

Fig. 163.



Back-lash Spring.

Fig. 164.



Back-lash Spring, applied to Tumbling-rod Coupling.

Fig. 163 shows a bevel-wheel with spring in a case.

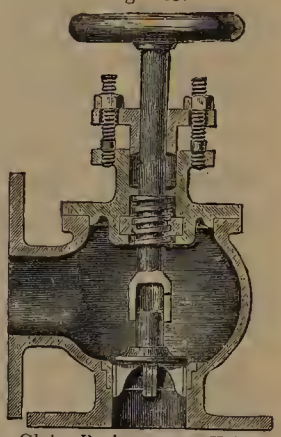
Fig. 164 shows a spring in a case to form part of line-shaft of a horse-power.

See also BACK-LASH, p. 206, "*Mech. Dict.*"

Back'-log. A casting or a work in earthenware in semblance of a back-log or pile of wood, and hollow to admit gas from the service-pipe. The surface of the back-log has minute perforations at which gas is emitted and burned, resembling a log on fire.

Back-press'ure Valve. A valve which is free in the normal direction of the flow, but closes automatically against back-pressure.

Fig. 165.



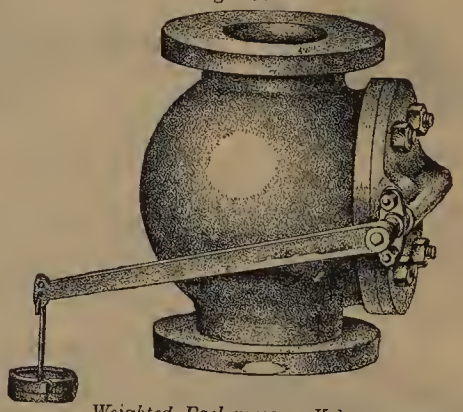
Globe Back-pressure Valve.

In the sectional view, Fig. 165, the valve can be screwed down tightly, but normally yields to upward flow, and is closed at any time against downward flow.

In Fig. 166 the valve is normally closed by a weighted lever, but yields to direct pressure of a given tension while always opposed to any return current.

Back Saw. One with a stiffening bar at the back. That shown in Fig. 167 has a back less than the full length of the saw, and has a recess in the handle for the thumb.

Fig. 166.



Weighted Back-pressure Valve.

Back Skin. (*Mining.*) A leathern covering worn by miners when working in wet places.

Back Spring. (*Vehicle.*) A spring at the rear of a vehicle body, but more especially a C-spring which rides up in the rear of the carriage, and from the forward pendent end of which the body is suspended. A pair of C-springs is shown in Fig. 1541, page 655, "*Mech. Dict.*"

Fig. 167.

Back-saw.

Back Stay. In a carriage: (1), one of the rods extending from the reach or perch to the outer end of the hind axle. The *stay-end* is the end-piece, which is fitted to the axle, and is sometimes sold separately as a piece of carriage hardware, the lengthening-rod being added by the blacksmith.

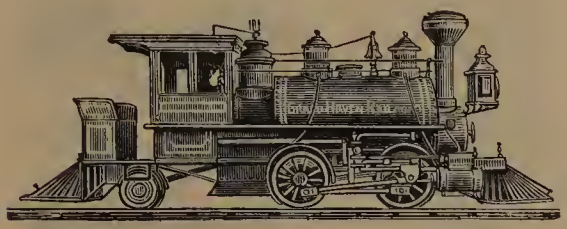
2. One of the standing flaps on the back of the carriage-top, on each side of the curtain.

Back Strap. (*Manége.*) A broad strap used instead of a pad on common harness. In some sections of the country the strap that extends from the hames back to the hip-straps is more generally known as the *turn-back*.

Back'-truck Lo'co-mo'tive. One having a truck with a pair of wheels under the rear of the

locomotive, as distinct from the usual truck in front of the drivers. The engine is intended to run equally well in either direction, being, in fact, a double-ender, adapted for sharp curves and steep grades. The 9 × 16 and 10 × 16 engines of this style are well adapted to suburban roads and special service on wide or narrow-gage roads, and light shifting on wide gage.

Fig. 168.



H. K. Porter & Co.'s Back-truck Locomotive.

A 4-wheel truck is sometimes substituted for the 2-wheel, the tank being placed over the rear truck.

Baf'fle Plate. (*Steam.*) A plate in a steam-furnace, to direct or divert the course of flame and gases. Placed in a space traversed by water-tubes, it will determine the course of the heated gases toward portions of the boiler which would not otherwise be as fully exposed to the heated current.

Bag. (*Fishing.*) The middle portion of a large haul-seine, the last to come ashore. The portions on each side of the bag are the *wings*.

Ba-gasse' Dry'er. An apparatus for drying the refuse cane-stalk from the mill. Page 208, "*Mech. Dict.*"

Berry, Br. . . . . * "*Engineering*," xxix. 204.
* "*Engineering*," xxx. 482.

Bag Ear-syr'inge. An ear douche, with elastic rubber bag for ejecting the liquid.

Bag Fill'er. A funnel used in filling bags. See also BAG-HOLDING TRUCK. Machines on a larger scale for filling flour-bags of various dimensions are shown under FLOUR PACKER.

Fig. 169.

Bag Filler.

Bag'gage Bar'row. A two-wheel hand-vehicle for conveying trunks. See Fig. 170.

Bag'gage Truck. A hand-truck adapted to receive trunks. Fig. 171 shows the pattern used on the Eastern Railway of France.

Bag-hold'er. A device to hold a bag or sack while being filled. There are many varieties: a truck which holds the bag: a funnel held upon a tripod, or on the end of a weighing beam, etc. See BAG-HOLDING TRUCK; SACK LIFTER; SACK FILLER, etc.

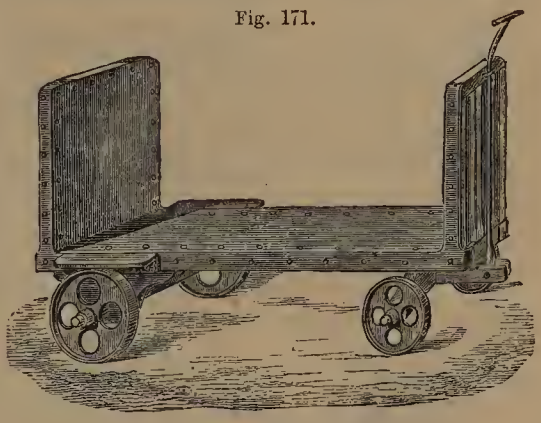
Fig. 170.

Baggage Barrow.

Fairchild's bag-holder has a metallic funnel attached to a standard, and to the funnel are attached four steel hooks which hold the mouth of the bag distended while being filled.

Mosher's bag-holder has two telescopic standards, with curved flanges to hold the bag.

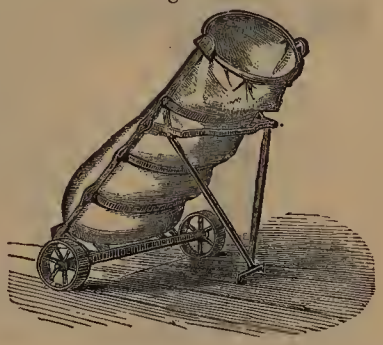
Fig. 171.



Baggage Truck.

Bag-hold'ing Truck. The bag-holding truck of Bodin of Rennes, France, is shown in Fig. 172. It has a slanting frame, supported by a strut, and a clip-ring at top to hold the distended mouth of the bag.

Fig. 172.

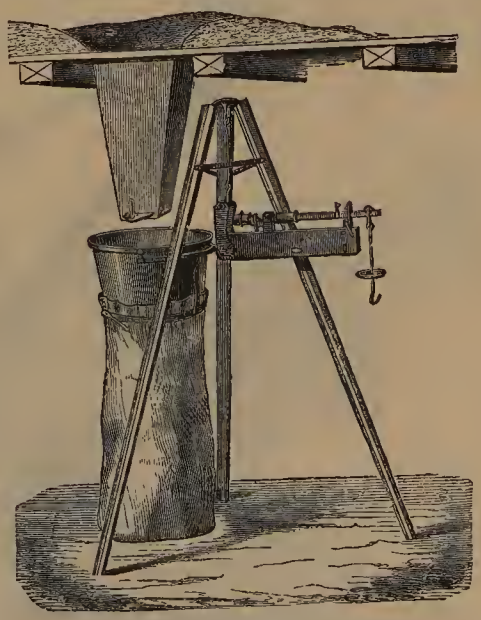


Bag-holding Truck.

A similar device is made by Pitner of Chicago.

Bag'-net. (*Fishing.*) A purse-shaped net, or part of a net. In some cases a sort of dip net, like Fig. 3318, p. 1522, "*Mech. Dict.*;" sometimes a portion of a net into which fish collected by the wings are driven or led. See list under NET.

Fig. 173.



Romaine's Sack-filler and Weigher.

Ba-gra'tion Bat'te-ry. (*Electricity.*) One in which the zinc and copper elements are immersed

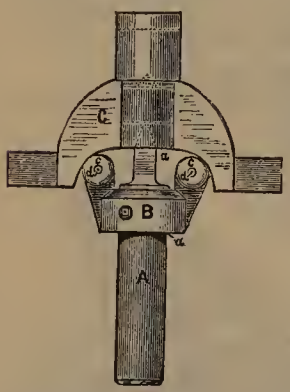
in a jar filled with earth, sprinkled with chloride of ammonium. — *De la Rive.*

Bag Weigh'er. Fig. 173 shows a French device.

A tripod supporting a scale-beam, on one end of which is a funnel to which the open mouth of a bag is clamped. The bag hangs beneath a spout, and when a prescribed weight of grain has passed from the spout into the sack, the shutter is closed, the bag removed and tied, and an empty sack substituted. The bag is clipped by a ring to the funnel, which is suspended by a notch on the end of the weigh-beam. The scale is centessimal, — the scale-weight being one-hundredth of the weight of grain which makes its equipoise.

Bail. (*Milling.*) The arch-shaped support of a mill-stone. The *balance-rynd.*

Fig. 174.



Bacon's Cushioned Bail and Driver.

In the figure, *C* is the bail resting upon the cock-head *a* of the spindle. *B* is the driver, with two cushioned horns, *c d*, which in the figure are exposed to view by the lifting of the bail out of place, but in operation occupy recesses in the bail.

The cushions, being yielding, allow the stone to be self-balancing.

Bain-Ma'rie. A water-bath; used in perfumery manufacture. See for particulars p. 398, vol. vii., "*Chambers' Encyclopedia,*" article "*Perfumery,*" where is given an interesting account of the flower-farms and processes of the Var, France.

"*Art of Perfumery,*" *Septimus Presse.* London, 1855.
"*British Perfumer,*" *C. Lilly.* London, 1822.
"*Libraire Roret,*" *Mme. Celnart.* Translated by Morfit of Philadelphia.
"*Treatise on Perfumery,*" *Pradal & Malepeyre.* Translated by Dussauce.
"*A Practical Guide for the Perfumer,*" *Dussauce.*

Bait, Ar'ti-fic'ial. (*Fishing.*) Tin minnows, roach, dace, and gudgeon.

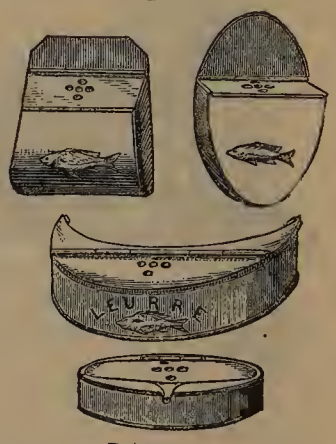
Gutta-percha minnows.

Tin blue-fish squids.

White bone blue-fish squids.

Insects: Imitations of grasshoppers, hornets, beetles, spiders, wasps, May-grubs, grubs, etc.

Fig. 175.



Bait Boxes.

Kellogg's patent, No. 74,378, is for an ice-chest for bait, for fishing-vessels.

Burnham, No. 84,855, uses a saturated solution of lime to preserve bait.

Thorp's fish-bait, No. 96,288, is a baked cracker, made of equal parts of coarsely-ground wheat, oats, rye, and corn.

Goodman, No. 135,113, uses to make bait more attractive, oils of anise, asafœtida, and cardamons; black root and buzzard-flesh (!) a few drops on the bait.

Bait Box. 1. The cistern or tank in which bait of fish or clams is carried to the fishing-grounds.

2. On a smaller scale, the angler's bait-can for worms or what-not.

Kepner's can for live bait, No. 163,498, has a perforated false bottom and openings at the sides, to allow circulation of water when the can is set therein

Hitchcock's bait-kettle, No. 181,844, has ice-cooler, minnow-bucket, and trays.

Lasater, No. 194,253, has a combined minnow-trap and can.

Bait Cut'ter. A bait-cutting machine. See BAIT MILL.

Bait Mill. A grinding mill to mince bait, frequently on the principle of a sausage-cutter.

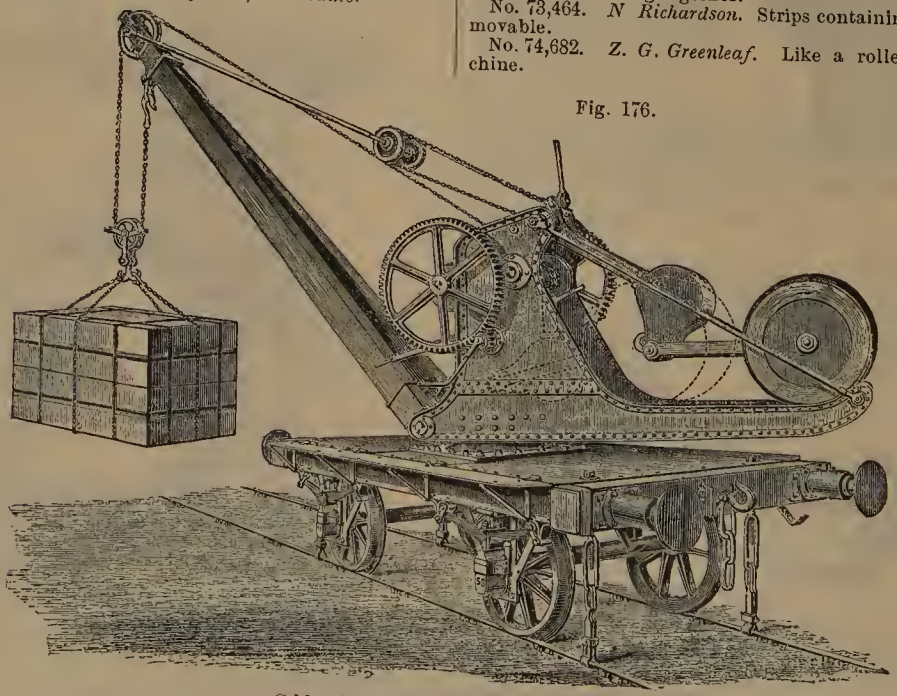
UNITED STATES PATENTS.

No. 35,472. *N. Richardson.* Triangular teeth on each of two rollers, working together.

No. 73,464. *N Richardson.* Strips containing teeth are removable.

No. 74,682. *Z. G. Greenleaf.* Like a roller sausage-machine.

Fig. 176.



Self-acting Balance Permanent-way Crane.

No. 83,048. *V. Doane.* Roller-knives and stationary blades.
No. 101,260. *S. Hamblin.* Knives spirally arranged on roller.
No. 129,576. *W. M'Kay.* Circular saws on roller.
No. 172,777. *N. Richardson.* A roller cutter-mill.
Voss, 1876. Like a sausage-cutter.

Bal. (*Mining.*) Cornish — a mine.

Balance Crane. One in which the load is in part or entirely balanced by a counterpoise on the crane-frame extension.

The manner in which the load on the lifting-chain acts on the counter-balance weights will be readily understood from the engraving, Fig. 176. The rigid rods which tie the jib-head to the side-frames in ordinary railway-track cranes are here replaced by two short tie-rods, each with a chain-sheave at its lower end. One end of each of the chains passing over these sheaves is attached to a chain-barrel fitted with worm and wheel-gear, while the other ends are coupled to the short arms of two bell-crank levers, having a fulcrum in the top of the side-frames; the lower ends of the long limbs of the bell-crank levers are fitted with weights connected by strong wrought-iron links to the axis of a cylindrical balance weight, which is free to roll on the tail-pieces of the crane framing. When the load is being lifted the strain due to the weight of the load passes through the tie-bars and chains to the short arms of the bell-cranks, and the strain thus applied causes the long arms and weights to rise out of the vertical position and to draw the cylindrical weights into the position shown, or until they are at a distance from the center sufficient to counterbalance the load being lifted. When the load is released, the levers resume the vertical position shown in the dotted lines.

The action is therefore entirely automatic, there are few parts, none of them liable to derangement, and all so strong and simple in construction that these cranes have never been known to fail in securing the safety and certainty which they were designed to afford.

The chain-barrel is fitted with a tangent wheel and worm which serve to adjust the jib to any angle or radius required, as well as to lower it down for traveling.

The under carriage and side-frames are of wrought iron.

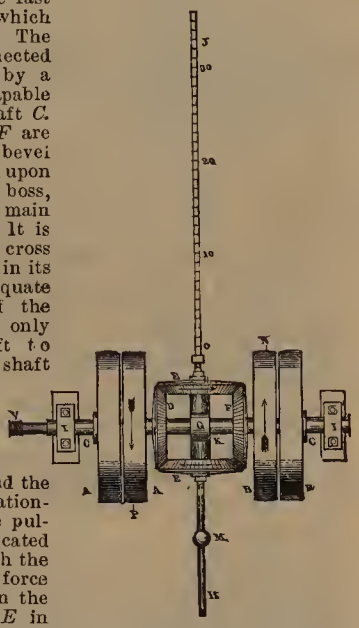
Bal'anced Draw'bridge. A counter-weighted bascule or lifting drawbridge. Instances are to be found in the drawbridges of fortifications, of counterpoising by means of suspended weights from chains passing over pulleys.

Burdon's drawbridge balanced by hydraulic pressure is shown in "*Manufacturer and Builder*," * xi. 29.

Bal'ance Dy'na-mom'e-ter. An invention of Samuel Batchelder of Boston. It is placed in the line of communication between the motor and the machinery to be moved, the power exerted on the machinery being measured by the steelyard and weight which form a part of the machine.

A A and *B B* are two pairs of belt pulleys, each pair consisting of a fast and loose pulley. *A* is driven by a belt from the prime motor, and a belt from *B* communicates motion to the machine to be driven.

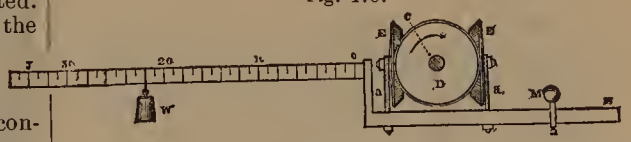
Fig. 177.



Balance Dynamometer (Plan.)

The first pulley, *A*, and the bevel wheel *D*, are fast upon the shaft *C*, which revolves in bearings *I*. The bevel wheel *F* is connected with the pulley *B* by a sleeve, *K*, which is capable of turning on the shaft *C*. The bevel wheels *D F* are geared together by the bevel wheels *E E*, which run upon a cross shaft having a boss, *G*, through which the main shaft passes freely. It is evident that if this cross shaft is not retained in its place by some adequate force, the motion of the bevel wheel *D* will only cause the cross-shaft to move round upon the shaft *C*, and the wheels *E* will roll upon the wheel *F*, without communicating motion to it or to the pulley *B*; but if the wheels *E* and the cross-shaft are held stationary, the motion of the pulley *A* will be communicated to the pulley *B* through the bevel wheels, and the force there applied to retain the shaft *G* and wheels *E* in place will indicate the power transmitted through the dynamometer. The amount of power is ascertained by means of a graduated scale beam, *H J*, connected with the shaft of the wheels *E* by straps, *a*.

Fig. 178.

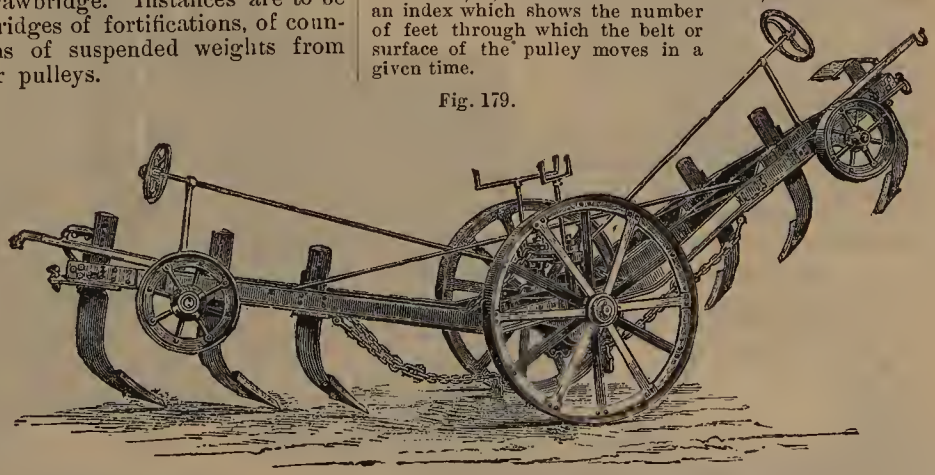


Balance Dynamometer (Elevation).

The weight *M*, fastened to the shorter arm of the graduated beam by a set screw, affords a means of balancing the beam when the machine is at rest, and the weight *W*, like that of a common balance, moved on the graduated arm of the lever, will indicate the strain upon the belt. The number of pounds thus indicated multiplied by the number of feet through which the belt moves per minute will give the number of pounds raised one foot high per minute. The product divided by 33,000 gives the horse-power expended in driving the machinery.

A worm, *Y*, on the end of the shaft *C*, is made to move an index which shows the number of feet through which the belt or surface of the pulley moves in a given time.

Fig. 179.



Balance Plow.

Bal'ance En'gine. A name applied to a form of steam-engine which has two pistons acting in opposite directions in the same cylinder. For instance: —

Wells . . "*Engineer*," *xlvii. 332.
"*Scientific American*," xxxv. 281.
"*Engineering and Mining Journal*," xxvii. 237.

Bal'ance Plow. A plow used in steam culture. The ends are duplicates, one balancing the other, as shown in Fig. 179. The implement is drawn across the field, back and forth, without being turned at the ends. When it reaches the end of its course the plows are lifted from the ground and the other set lowered to do the plowing on the return trip. See STEAM PLOW, pp. 2354–2356, "*Mech. Dict.*," *et infra*, for installation and method of working.

Bal'ance-wheel Turn'ing Ma-chine'. A machine-tool for the automatic turning of the circular rims of balance wheels, such as are used upon sewing-machines and other light machinery. The work is performed by two tools operating upon opposite sides of the wheel at the same time. These tools are automatically revolved in a horizontal plane, about the rim of the wheel, in opposite directions, so that one-quarter revolution of each tool-post completes the half-circle, and then both spindle and tool-posts cease revolving.

The centers around which the tool-posts revolve are adjustable, and allow a variation in the size of wheel to be turned, of from 6″ to 7″ in diameter. This adjustment is made by simply turning a screw. The feed-works are inclosed in the base of the machine, and are readily accessible for oiling, etc. The cone has two speeds.

See "*Scientific American*," *xxxviii. 271.

Balance-wheel adjusting apparatus.
Ide . . . . . *"*Scientific American*," xlii. 307.

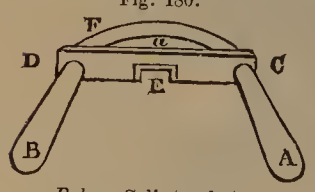
Ba-la'ta. The gum of the *Achras dissecta* of the family Sapoteæ (Mex. Zapotl) found in Guiana, and having properties similar to gutta percha. It may be vulcanized by digesting with sulphur.

Bald'win Bit. (*Manége.*) A bit having two mouth-pieces, the inner one working on levers; claimed to possess superior advantages over others for driving horses that are hard to control or have bad or vicious habits.

Ba-leen'. Views and diagrams showing the manner in which the baleen (whalebone) is arranged in the head of the whale (*Balæna mysticetus*) were given in "*Land and Water*," 1877, and republished in "*Scientific American*," xxxviii. 88.

The house of Meyer, in Hamburg, is probably the largest manufacturer of whalebone wares and walking-sticks in the world. The value of the produce of the former in 1871 was £362,000, and the number of sticks and whips was 175,000 dozen, valued at £65,000.

Fig. 180.



Baleen Splitting-knife.

Ba-leen' Knife. A knife used in splitting the baleen into rods of the required size.

The baleen is held in a bench-vise and split in the direction of its fibers. The knife, Fig. 180, has a curved blade, *F*, in a metallic plate, *C D*, with handles *A B*. The knife-edge is parallel with the upper edge of the directing notch *E*.

Bale Hooks. 1. Large lifting-hooks suspended in pairs from the chain of a crane or winch. See Fig. 181.

2. Small hand-hooks, Fig. 182, used by 'longshoremen in handling bales.

Fig. 181.

Fig. 182.

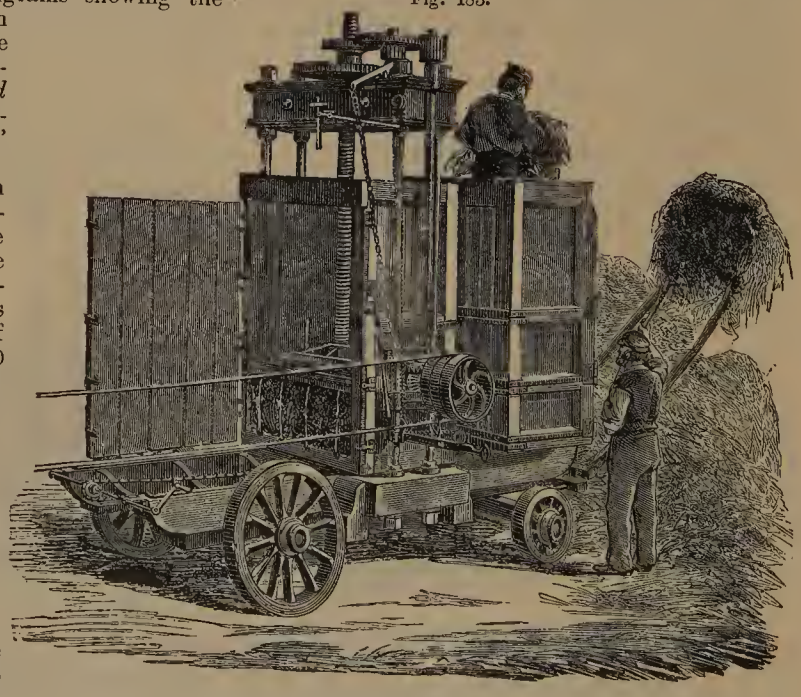
Bale Hooks.

Bal'ing Press. Two continuous baling presses took high honors in Paris in 1878,—those of Dederick and Dodge.

The former has a plunger or piston in connection with a reciprocating feeder, which drives a bunch of hay within the range of the plunger before each stroke of the latter. A certain quantity being thus compressed into a compartment at the end of the chamber, is tied with wire and dropped from the machine.

In the Dodge machine the hay is thrown loosely on the feed-table or troughs in front of the press, whence iron teeth carry it right into the open mouth of the machine, when it is seized by the revolving cones in the head-piece and drawn in from the feed-table in two continuous streams, and built up into a bale 26″ in diameter. The diameter of the bale is never increased, but the bale grows longer as layer after layer is built up. In doing this the density of the bale is regulated by the friction-clutch, which has been previously made tight. After the bale is built such length as desired, the action of the compress-screw is brought into play by simply shifting one cog-wheel, and in a few seconds

Fig. 183.



Mabille Frères' Hay Press.

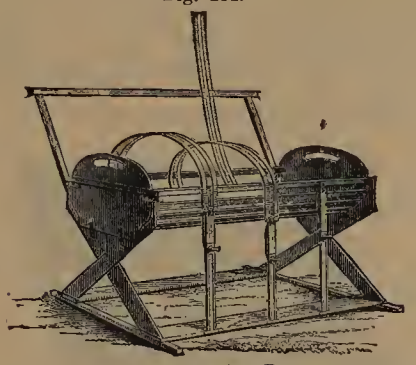
the bale is compressed endwise and shortened about one-fourth or one-fifth its length without increasing its diameter. While the compression is going on, the man attending the press is passing around and fastening the two wires. When this is done, the pressure is released, the bale dropped out, and the press set for another bale.

Fig. 183 represents a baling press, made by Mabille Frères of Amboise, and worked by horse-power. The rotation of the band-wheel is transferred by bevel gearing to the vertical shaft, and that by spur pinion to the system of gearing on top of the machine, which is of different speeds and powers for rapid work at the first of the pressing, followed by slower and more powerful condensation as the truss approaches its final dimensions.

A multitude of small baling presses are used in France, both for packing rations for cavalry and for stowing away in convenient form for handling, the straw or hay of a farm.

One of the smaller kind is that made by Guitton of Corbeil, France. It has three pliable steel bands, which are

Fig. 184.



Guitton's Ration Press.

laid back against the bar (one is shown in this position) while the crate is being filled. The bands are then laid over, the ends brought down in front, and secured to hooks. These are forcibly drawn down by pressing the foot on the treadle, each band being in turn attached, a catch holding each firmly until the encircling cord is placed and tied. Each steel band being then released, the bundle is thrown out.

The machines make bundles from 30″ to 40″ long. A larger size, made on the same principle, but mounted on wheels, makes bundles of from 60 to 80 lbs. weight.

See baling presses, etc.: —

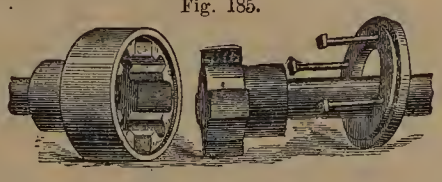
Ertel . . . . . * "*Min. and Sc. Press*," xxxvii. 25.
Albaret . . . . . * "*Scientific American Sup.*," 1949.
Bale Tie, *Hayden* . . * "*Scientific American*," xxxv. 310.
Rodecker . . . . * "*Sc. American*," xxxviii. 229.
Hoop Tightener.
Knowles . . . . * "*Scientific American*," xxxv. 274.
Bale-wire Ends, Securing.
Smith . . . . . * "*Scientific American*," xxxv. 66.
Trussing, *Guilhem*, * Knight's Report.
" *Paris Exposition Report*," v. 236.
Ration, *Guitton* . . . *Ibid.*, v. 237.

Balk. (*Agriculture.*) The space between rows of plants in a field, as of corn or cotton.

Bal'land. (*Mining.*) Derbyshire: Dusty lead ore.

Ball and Sock'et Coup'ling. A coupling which, by affording a joint, permits flexure.

Fig. 185.



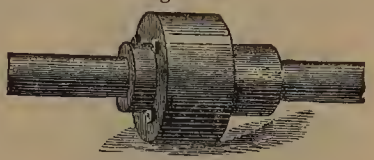
Ball and Socket Coupling. (*Parts Detached.*)

Figs. 185, 186, show a ball and socket coupling for line shafting, — a more compact device than the gimbal joint of the tumbling shaft.

It has not a perfect ball, but the leaves are the equivalent, and operate against plates in the case. The rounded edges of the leaves allow flexure without cramping. A divergence from the straight of 5″ in 12′ is readily permitted.

Ball and Sock'et Hang'er. One the axis of the opening in which is adjustable so as to be capable of being brought in line with a shaft.

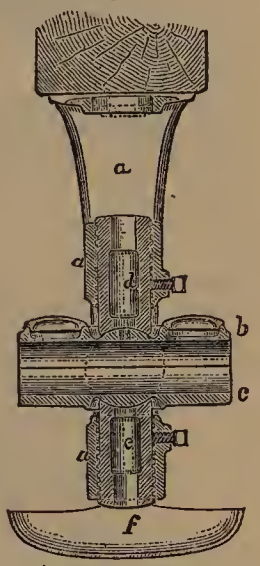
Fig.. 186.



Ball and Socket Coupling. (*Parts Connected.*)

In Fig. 187, *a* is the frame or hanger; *b*, the upper, and *c*, the lower portion of the box. This box is provided, top and bottom, with spherical surfaces, so placed as to be, in reality, portions of a sphere which has its center in the center of the axis of the box; *d* and *e* are what are called the plungers. These are screwed into the frame, and are provided with cup-shaped ends to clasp the spherical parts of the box. The box can rock to a limited extent in every direction in these cup-shaped ends. The plungers serve a double purpose: 1st, of providing the socket for the sphere to roll in; 2d, to permit of a vertical adjustment of the entire box to bring them in line one with another; *f* is an oil dish to catch the drippings from the box.

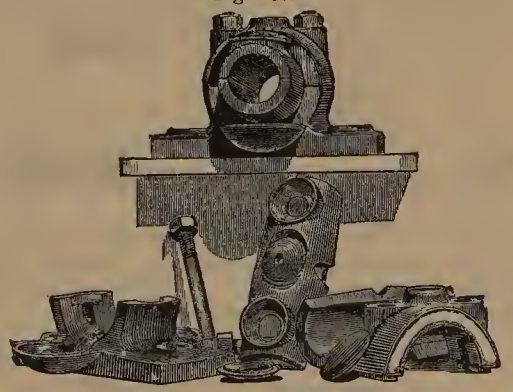
Fig. 187.



Ball and Socket Hanger.

Ball and Sock'et Pil'low-block. One which is capable, within certain limits, of accommodating itself to the line of direction of the shafting.

Fig 188.

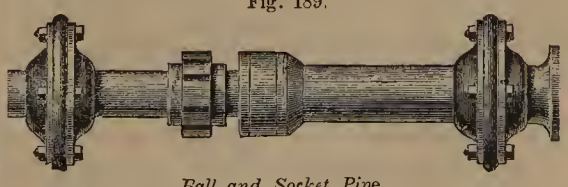


Ball and Socket Pillow-block.

Fig. 188 shows a ball and socket pillow-block, and beneath it are all the parts, detached.

Ball and Sock'et Pipe. One having a flexible joint which permits the sections to be laid out of mutual line.

Fig. 189.



Ball and Socket Pipe.

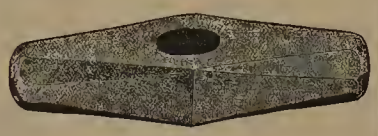
The illustration shows a pipe with two such joints, each inclosed with casing plates bolted to-

gether. The ball at the end of one section rolls in a spherical cavity in the other, as shown in section in Fig. 541, p. 219, "*Mech. Dict.*"; but in the present, each section is tubular.

Ball and Sock'et Truss. (*Surgical.*) One, the pad of which is attached to the strap by a ball and socket joint which allows the pad to adjust itself to the surface of the body.

Bal'last Ham'mer. A track-layer's hammer, having two rounded faces, and used in packing the ballast beneath ties, and also, on occasion, in driving spikes.

Fig 190.



Ballast Hammer.

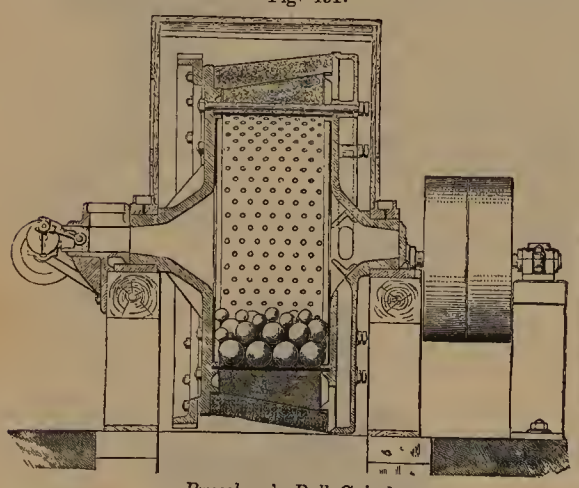
Ball-cock. 1. One in which a globular valve takes the place of a disk, spigot, sliding plate, etc., which are other forms of devices for closing an aperture in a pipe.

2. One opened or closed by a lever attached to a floating ball. See Fig. 234. See also p. 220, "*Mech. Dict.*"

Ball valve, Br. *Jefferies* . . . *"*"*Engineer,*" xlvi. 377.

Ball Grind'er. A pulverizer for minerals. It depends upon the attrition of spheres rolling inside a rotating cylinder, the periphery of which is provided with a cast-steel ring, perforated with

Fig. 191.



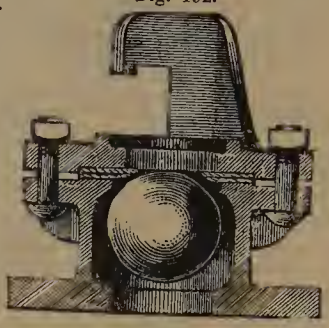
Brueckner's Ball Grinder.

small holes. The heads of the cylinder are made of heavy cast iron, lined with steel. It is filled with steel balls from 2″ to 5″ in diameter, in quantities of 1,000 to 1,200 lbs for a 48″ cylinder. The steel ring is the crushing plate upon which the balls, by a combined stamping and grinding action, break up the material to a size varying from a powder to the size of the holes of the ring. The broken material which has passed through the holes of the steel plate, is sorted by the first wire-screen, all that are larger than the mesh being returned to the grinding chamber by the passage shown on the right hand. This process is repeated on the second outer screen, which regulates the size of the final product, all stuff not coming up to the required degree of comminution also being returned to the grinding chamber.

"*Iron Age*," February 20, *xxiii., p. 1.

Ball Hy'drant. One having a metallic box containing a self-acting globular valve of gutta-percha or material relatively lighter than water, so as to be normally closed against its seat by its levity, and more firmly by the pressure beneath it. The top of the box has two L lugs so as to form a bayonet-joint with the portable stand-pipe to which it is attached.

Fig. 192.



Ball Hydrant.

Ball'-joint Hinge. One having a flexible knuckle. In the form illustrated it is a hinge for a stern-post shutter; when made on this principle each can be adjusted, in fixing, to the bevel of the post, so that hinges from one pattern will answer for all the different rakes and bevels of the various posts. See Fig. 193.

Ball Mount'ing. (*Manége.*) A pattern of harness mountings having a ball at the point where the ring is attached to the base.

Fig. 193.

Ball-joint Hinge.

Bal-loon'. *Hartness's* sectional balloon, the parts resembling the lobes of an orange, was patented May, 1874. This is a substitute for the gores of which the balloon is ordinarily made, and prevents the puncturing of a section from being fatal to the whole. It is like making a ship's hull or a life-preserver in compartments.

See the following notices: —

Balloons . . . . . "*Scientific American Sup.*," 792.
Giffard's Captive Paris, 1878. . *"*"*Scientific American*," xxxix. 130, 154.
""*Engineering*," xxvi. 106, 231, 127, 214.
""*Scientific American Sup.*," *726, 2021, *2320.
"*La Presse Illustrée*," ix., No. 539.
Captive "Pioneer" . "*Scientific American*," xli. 32.
Captive, *Badgley* . *"*"*Scientific American*," xii. 18.
Military, Eng. . . "*Scientific American*," xxxix. 326.
Military, sectional . "*Iron Age*," xxiv., July 31, 1.
Voyage to North Pole, proposed, Eng.
""*Scientific American*," xxxvii. 375.
""*Scientific American*," xli. 183.
On Aëronautics, *Gerner* "*Van Nostrand's Mag.*," xix. 439.

Bal-loon' Bat'te-ry. (*Electricity.*) A form of Daniell's or Meidinger's battery in which an inverted flask forms a reservoir of crystals and liquid, the mouth of the flask being below the surface of the liquid in the cell.

Niaudet. American translation, *101.

Bal-loon' Mus'ket. One for perforating balloons of observation. As specially made by Krupp for the German army it was designed to pick off the postal balloons from Paris during the siege of that city. It was a heavy rifle swiveled on a standard upon an artillery wagon. — "*La Nature.*" Its range enabled it at times to pick off balloons at 3,200 feet elevation.

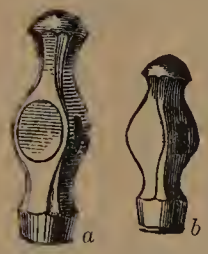
"*Scientific American Supplement*," *638.

Bal-loon′ Tor-pe′do. A torpedo elevated and floated over an enemy by a balloon, and dropped by time arrangement (fuse or clockwork), or by means of electric connection through wire reaching from the point of dispatch.

"*Scientific American*," xxxvi. 404.

Ball′-peen Ham′mer. One whose peen is rouud, or ball-shaped. See PEEN, "*Mech. Dict.*"

Fig. 194.



Ball-peen Hammer.
a. Hand-hammer.
b. Riveting Hammer.

Ball Probe. (*Surgical.*) A urethral sound; a slight staff with a ball on the end. The *olivary bougie* or *bougie à boule* are of similar character but different proportions. Page ii., Part III., *Tiemann's Armamentarium Chirurgicum.*"

Ball Seat′er. A tool used in loading metallic shells, to place the axis of the ball accurately in line in its seat in the shell. See RELOADING TOOLS.

Ball Trim′mer. (*Cartridge-making.*) The balls after they come from the bullet machine are trimmed both side and end by this machine, working on the principle of the lathe.

Bal′us-ter Lathe. A lathe for turning articles of wood which have to be frequently repeated, such as ornamental stair-balusters, the legs of tables or chairs, bed-posts, etc. Between the head-stocks a sliding-frame is arranged and fixed to suit the dimensions; this slide contains two knives, both the entire length of the article, the one knife to rough out nearly to size in advance of the one to finish; both are set on the skew in order to take the work in detail; the first blade merely brings the piece of wood approximately to form, while the other blade is cut out exactly to pattern with all the irregularities of the required article. One passage of the slide with its two instruments in moviug past the revolving articlc fiuishes the work.

Bam-boo′. A plant of the grass family. The tubular stem is of great use iu the mechanic arts, and the splits therefrom are used iu making mats, baskets, etc.

Bamboo, uses of . . "*Scientific American*," xl. 279.
"*Scientific American*," xlii, 240.

Band. The metallic cap on the outside of the hub or nave of a vehicle. Made of many fancy patterns for carriages of luxury.

Ban′dage. (*Surgical.*) A wrapping, support, or dressing of various kinds and uses. For instance (the figures refer to "*Tiemann's Armamentarium Chirurgicum*," Part IV.): —

Abdominal bandage, for supporting the abdomen after parturitiou, etc. Figs. 40–44.

Suspensory, for the scrotum. Fig. 46.

Umbilical, a truss for the umbilicus. Fig. 16.

Fracture, various in kind, material, and mode of application. Figs. 122, 123, 125–127.

Esmarch's tourniquet. Fig. 184.

Rubber, vulcanized gum cloth.

Roller, cloth in strips.

Plaster-of-Paris, cloth saturated with a thin paste of gypsum, placed on a part of the body to harden *in situ.*

Carbolized, saturated with solution of carbolic acid. See also p. 225, "*Mech. Dict.*"

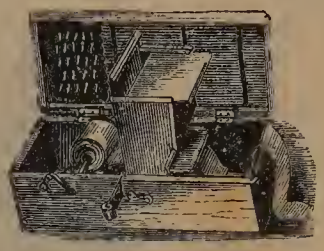
Ban′dage Shears. Curved-tip shears for trimming and cutting bandage cloth; or in cutting away portions of a plaster-of-Paris fracture bandage for inspection.

Figs. 165, 189, 202, 203, 204, Part IV., *Tiemann's "Armamentarium Chirurgicum.*"

Ban′dages, Plas′ter Spread′er for. The device, Fig. 195, is for simply rolling baudages, or to apply silicate of soda, dextrine, or plaster simultaneously with the winding process.

"*Medical Record*," October 13, 1877.

Fig. 195.



Dr. Greene's Bandage Winder and Plaster Spreader.

Band Cut′ter. A tool for cutting the bands of sheaves, when feeding to the threshing machinc.

In the latest practice the band is of wire or string.

Graham and Haines . * "*Iron Age*," xxv., April 8, 9.
Chadbourne . . . . * "*Iron Age*," xxii., July 11, 20.

In some British threshing machines, the band is cut by a revolving knife iu the floor of the hopper down which the sheaf slides into the throat of the threshing concave.

Ban′de-role. The flag formerly known by that name was a company color.

Band′ing Ma-chine′. (*Hat Making.*) A form of hat-body blocking machine specially adapted to make the *band*, the term used in the trade for the sharp angle at the junction of the side-crown and brim. See BLOCKING MACHINE.

Band′ing Ring. (*Hat Making.*) The circular band which grips the hat at the band; the angle formed by the side-crowu and brim. It is used in hat-blocking machines.

Band In′stru-ments. See report on band instruments by *H. K. Oliver* on Group XXV., iu vol. vii., "*Centennial Exhibition Reports*," p. 50.

Band Mount′ing. (*Manége.*) A pattern of haruess the ring of which is broad and flat, with square edges.

Ban′do-leer′. A case containing a musket charge and fastened to the shoulder belt.

Band and Jig Saw Combined. (*Wood Working.*) A machine by Western & Co., of Londou, in which are provided alternative band and jig saws, each furnished with its own pulleys fixed and loose. The band is adapted to saw wood up to 10″ thick, and the jig up to 6″.

Band Saw. The band saw, consisting of an endless steel ribbon with serrated edge, is the invention of William Newberry, of London, England, and was patented in 1807.

M. J. L. Perin, of Paris, France, overcame the difficulty which long prevented the invention from becoming of general utility, and his celebrated blades are yet unsurpassed.

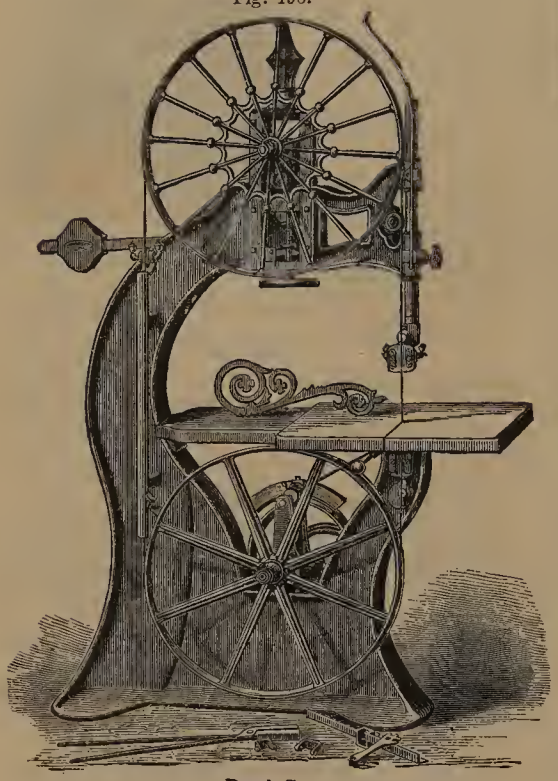
"Analyzing the peculiar principles of action of the band saw, it may be said to have a blade of superior thinness, capable of tension in varying degrees, moving in right lines through the material, at a speed that is almost unlimited, and capable of exceeding that of circular saws; operating too by machinery consisting only of rotating parts, and of the most simple construction, the sawdust all carried down through the timber, offering no obstruction in following lines.

"Add to this the peculiar adaptation of the band saw to curved lines, and its advantages cannot be over-estimated. The speed of sawing, or the cost of sawing, which is much the same thing as the movement of the teeth, is with the band saw almost unlimited. Its performance, contrasted with reciprocating saws for cutting plain sweeps or scroll work, shows a gain of time, or cost, of three or four to one, with the important advantage of being easier to operate." — *Richards.*

The latest form of band saw is shown in Fig. 196. The machine has a planed iron table pivoted for bevel sawing; a shipper with frictional brake, for arresting the motion of the saw; a vertical guide bar with retracting spring, for instantly adjusting it to the desired height; an elastic steel upper

wheel; cast steel shafts, with self-oiling boxes and adjustments to take up the wear; and methods of

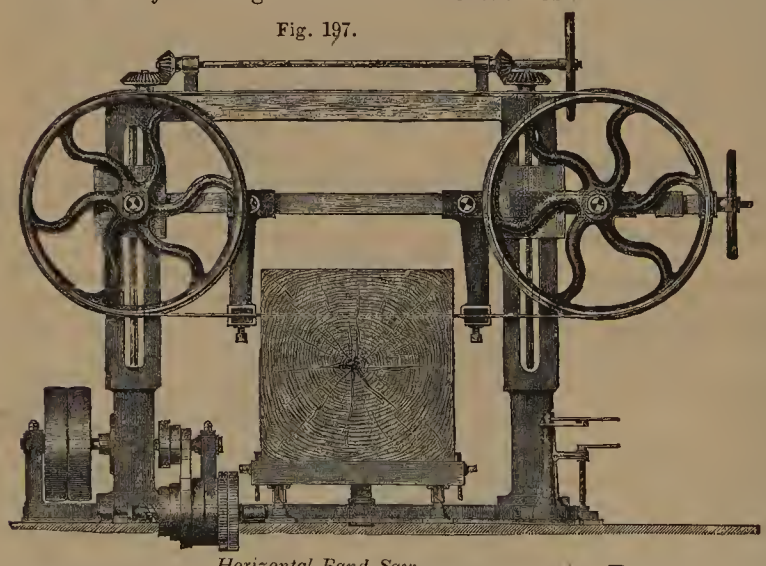
Fig. 196.



Band Saw.

keeping the saw at its proper tension, allowing at the same time flexibility to the parts, to compensate for any sudden impact, and prevent breakage of the saws by buckling or friction on the back or

Fig. 197.



Horizontal Band Saw.

sides. The weighting device gives positiveness to the amount of tension the saw is receiving, at the same time compensating for any variation in the length of the saw by change in temperature, or strain. Friction guide-wheels receive the back thrust of the saw, and wooden guides are provided at the side.

The following references to Band Saws may be consulted: —

Bentel, Margedant & Co.	* "*Engineer*," xli. 409.
	* "*Man. & Builder*," viii. 129.
Clement	* "*Man. & Builder*," xi. 184.
Fay & Co.	* "*Thurston's Vienna Rept.*," iii. 259.
	* "*Engineer*," xli. 463.
	* "*Sc. American*," xxxvii. 310.
Resawing Machine, *Fay*	* "*Sc. American*," xxxv. 31.
Hand power, *Frank*	* "*Sc. American*," xliii. 387.
	* "*Man. & Builder*," xi. 58.
For timber, *Furness*	* "*Engineering*," xxvii. 235.
Foot power, *Kimball*	* "*Iron Age*," xxiii., May 29, 1.
London, Berry & Orton	* "*Sc. American*," xl. 1.
Margedant	* "*Sc. American*," xxxiv. 70.
Newberry (1808), Br.	* "*Engineering*," xxix. 43.
Perin, Fr.	* "*Thurston's Vienna Rept.*," iii. 284.
Perin, Pauchard et Cie.	* "*Engineer*," xlvii. 293.
Polyblank, Br.	* "*Engineer*," xlvii. 171.
Ransome, Eng.	* "*Thurston's Rept.*," iii. 266.
Richards, London & Kelly	* "*Thurston's Rept.*," iii. 254.
Rogers	* "*Engineer*," xlvi. 134.
Whitney	* "*Thurston's Rept.*," iii. 253.
Worssam, Br.	* "*Engineer*," l. 245.

Band Saw'-mill. The band saw has been applied to the sawing of logs into boards, and the resawing of timbers. Three illustrations are given of English, French, and American machines respectively.

The horizontal band saw of Western & Co., of London, is shown in Fig. 197. It is shown as splitting into heavy balks a log already squared and mounted on a horizontally moving carriage. The saw wheels are simultaneously adjusted for height by a single wheel: for tension, by adjustment of the right-hand wheel. The saw guides are separately adjustable to the vicinity of the log.

Plate III. shows the band saw-mill of Arbey, of Paris. It has a continuous roller feed, pivotal table for bevel sawing, and the various adjustments for tension of the blade, elevation of the guide, approach of the feed rollers, etc.

Fig. 198 shows by side and end elevations the band-saw mill of Richards, London & Kelly.

It has wrought iron wheels 72″ in diameter, receives blades 45′ long to 5″ wide, and is shown operating upon a small round log. The wheels are covered with wood and faced with leather or gum: the upper one has an adjustment of 18″, the supports resting on springs which equalize the tension of the blades. The Perin saw blades are used. The wheel is carried on a steel shaft 3½″ in diameter, with brass bearings.

The guide stem is 3½″ diameter, of wrought iron, counter-balanced, and supported in iron brackets bolted to the main column. The lower guide is also mounted on an iron bracket, connected to the main column, and has no attachments to the floor. The lower or main shaft is 4½″ diameter, with bearings 12″ long. The tight and loose driving pulleys are 30″ in diameter, 10″ face. Thermatic oilers are applied to the bearings.

Band'-saw Hold'er. An apparatus (Fig. 199) used in brazing band saws. It consists of a holding device and brazing tongs.

File a taper for, say ½″ on each end of the blade, so that when brought together the ends will be of even thickness with the rest of the saw. When adjusted properly, so that the teeth will match, clamp in the scarfing frame, so that the ends will be pressed together. Wash the saw and solder with acid, place a slip of solder between the laps of the saw, heat the welding tongs, grasp the joint, and when the solder is melted allow the saw to cool gradually.

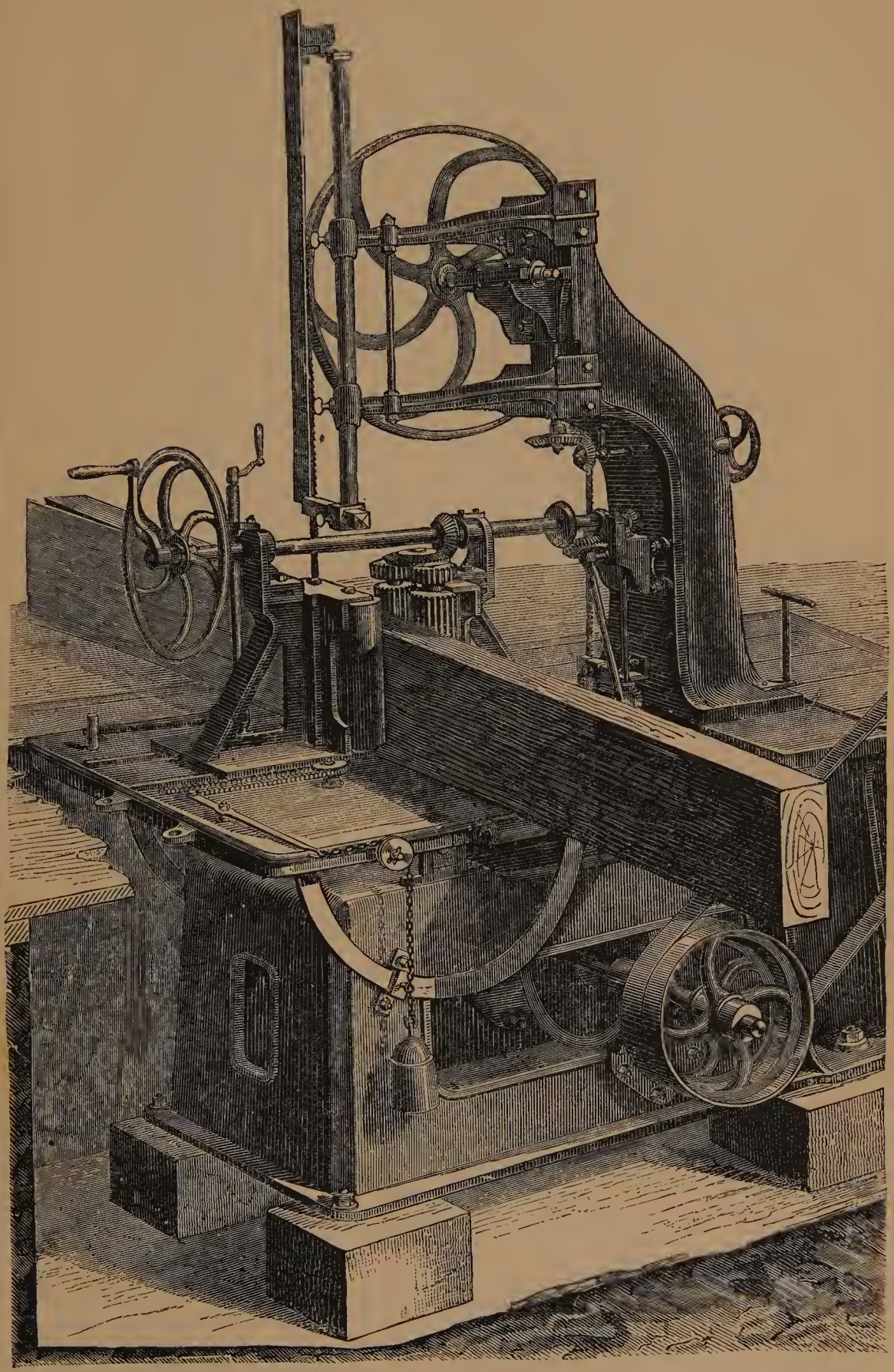
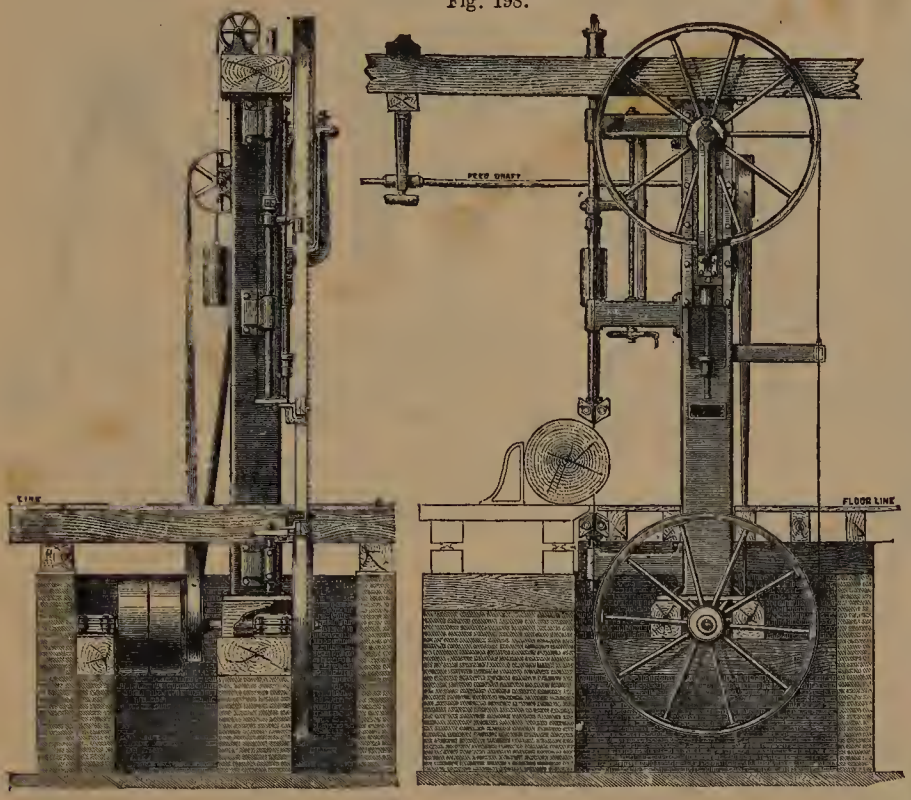


PLATE III. BAND SAW-MILL, BY ARBEY OF PARIS. See p. 72.

Fig. 198.

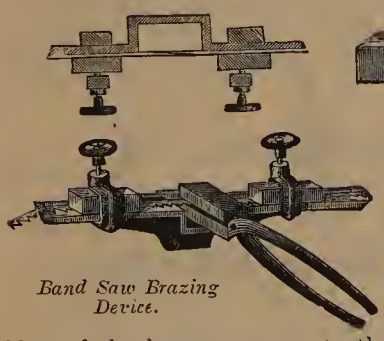


Band Saw-mill.

Band'-saw Set'ter. Fig. 200 is Richards' band-saw setting machine and filing frame.

The setting is done by a hammer in the hand of the operator. The saw is

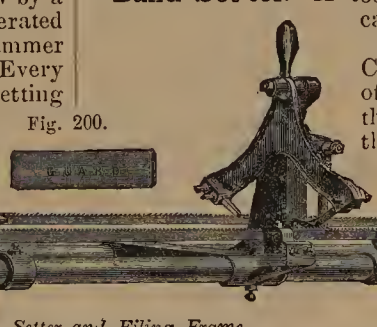
Fig. 199.



Band Saw Brazing Device.

strained and passes between two steel blocks, feed is imparted to the saw by a pawl, operated by the hammer handle. Every blow of the hammer sets a tooth, and the setting can be done at the rate of about 6′ per minute. The feed is adjustable to any pitch of tooth in an instant.

Fig. 200.



Band-saw Setter and Filing Frame.

should be raised so that the wheel can be made to

Fig. 202.

Band Setter.

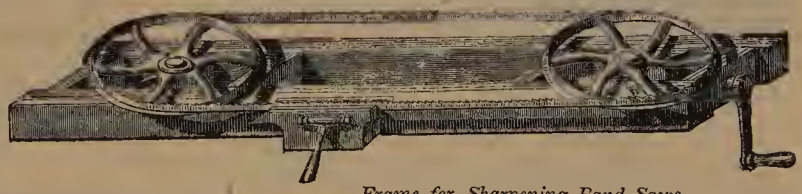
The machine is wholly of metal, except the rims of the wheels. The vise is arranged to close instantly for a length of 24″, by means of cams on the front.

Fay & Co.'s band-saw setter is a machine of similar character, the saw being strained upon the wheels and passing between the jaws of the setting machine. The feed pawl feeds two teeth at a time.

Band'-saw Sharp'en-ing Frame. A frame in which band-saws are stretched, and each portion of the blade clamped in turn, in order that it may be sharpened. When the clamp is slackened, the rotation of the crank brings a new portion of the blade within the loosened jaws of the clamp. See Fig. 201.

Band'-saw Tongs. A pair of flat-lipped tongs which are heated sufficiently to melt silver solder, and then clasped over the scarfed and

Fig. 201.



Frame for Sharpening Band Saws.

matched ends of a band saw, to melt the film of solder placed between the lapping edges. Shown in Band-saw Holder, Fig. 199.

Band Set'ter. A tool for setting bands on carriage wheels.

It operates as a plane. Cutter *B*, Fig. 202, pares off the surface on which the band is driven; *A* cuts the shoulder.

The end of the axle

revolve rapidly, and then, while the wheel is in motion, hold the plane to the hub until it is shaved off sufficiently to drive on the band.

Bank'-note En-grav'ing. The subject is considered on pp. 228, 2368, 2369, "*Mech. Dict.*"

Mr. George W. Casilear, Superintendent of Engraving in the United States Treasury, Bureau of Engraving and Printing, describes an improved method for engraving denominations or lettering upon lathe-work counters, used on bonds, bank

notes, and other securities, by the transfer process: —

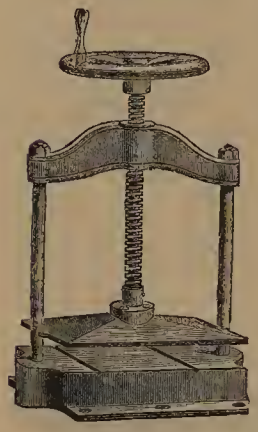
"Instead of proceeding as heretofore by hardening the die laid down from the shell, and taking up a roll for cutting out the white figures or letters, and then hardening the roll and laying down a second bed-piece for finishing with the graver, then in turn taking up a second roll called the finished roll. My improvement consists as follows, in taking the original die as made from the shell, and transferring with my numeral or alphabet rolls directly upon the face of the lathe work the required denomination or lettering. The parts of the lathe-work appearing over the face of the figures is then scraped and burnished away and a new surface gained, by having the die or plate set up from the back in the usual manner known by engravers and transferrers, using the precaution to have a bit of paper between the anvil and plate to protect the lathe-work, the paper only to cover those parts of the lathe-work which are to appear intact.

By this improved process a roll is saved, also a bed-piece, and the lathe work is purer and sharper, being transferred direct from the shell while there is no engraving of the denomination or figures on the die or plate, as the work is all done by the transferrer. The result being more perfect, and a great saving of cost."

Bank'-note Pa'per. See SAFETY PAPER.

Bank'-note Press. One for pressing and packaging bank notes. It has grooves for cords in the bed and follower, so that the notes may be tied up before the platen of the press is raised.

Fig. 203.



Bank-note Press.

Ban'ner. Formerly, the small, square flag of a knight, and charged with his arms.

Ban'ner Net'ting. For painted signs or banners to be hung across a street. The open work avoids injury by the wind.

Bar. Bars of furnaces are *bearer* bars, and *grate* bars; the former hold up the latter, and these the fuel.

Bar and Open Bead Sight. (*Rifle.*) A form of sight in which the *aperture* is supported on a segment plate in the ring. Fig. 204.

Fig. 204.

Bar and Open Bead Sight.

Bar and Slit Sight. (*Rifle.*) A form of sight having a plate with a vertical slit. Also called a *slit-bar sight*. See Fig. 205.

Fig. 205.

Bar and Slit Sight

Barbed Shot. (*Life-saving Apparatus.*) A ball having grapnels attached and intended to be fired from a mortar to carry a line between a shore and a stranded vessel, or *vice versa*.

Fig. 206

Barbed Shot.

Otherwise known as an ANCHOR-SHOT, or GRAPPLE-SHOT, which see.

Barbed Sca'ler. An instrument, Fig. 207, designed to pass between and around the necks of teeth which are loosened by old deposits of tartar. Being in pairs, with the barbed edges on opposite faces, they admit of application right and left, and on proximate surfaces. While holding the tooth with the finger upon it firmly in the socket, they can be used either by pushing to scale with the chisel edge, or by making the draw-cut with the barbed edge.

Fig. 207.

Dentist's Scalers.

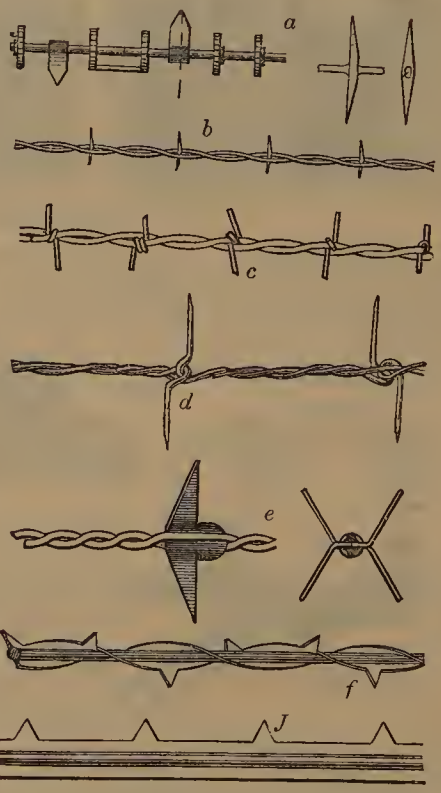
Fig. 208.

Barbing Pinchers.

Barb'ing Pinch'ers. A tool especially adapted for closing and clinching wire staples upon fence-wire.

Barb Wire. Wire with iron spikes or points clinched upon it, to prevent breaking by cattle when strung between posts as a fence.

Fig. 209.



Barbed Fence-wires.

Fig. 209 shows the prominent features in the history of the barb wire.

The upper illustration, *a*, shows the Hunt wire, a rough and incomplete invention, but involving the bottom idea, *i. e.*, a fence wire provided with spurs or barbs. Spur wheels or single spurs are shown attached to the wire.

b. Shows the next step, Kelly's patent, in which pointed spurs are strung on the wires and held to place by twisting a second wire around the first.

Glidden, *c*, substituted for the sheet-metal spur, a barb of wire twisted about one strand and held in place by the pressure of the other. The number of modifications of this idea is extremely large.

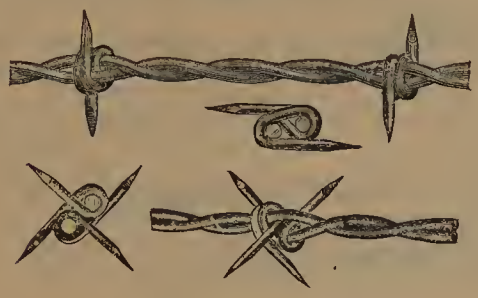
Haish, *d*, is the pioneer in that form in which,

with specially wrapped wires, the conjoined ends are hooked together and form projecting spikes.

Frentress, *e*, is probably the pioneer in that class in which separate sheet-metal plates, so cut as to have projecting barbs, are wholly fastened to the rod by twisting the wire.

In *f*, Allis's, the material is a rod with two flanges, one of which is cut into spurs and spaces, and the whole, being twisted, presents the barbs on all sides.

Fig. 210.



Two-spur and Four-spur Barb Wire.

Fig. 210 shows the barb wire in two forms, two-pointed and four-pointed. Each is shown in perspective and in cross-section. The cable consists of two strands twisted together, and the barbs are fastened between and around both strands, and their points stand out at right angles to the cable. The wire is painted, galvanized, or japanned.

Bar'-cut'ting Ma-chine'. A heavy shears for cutting bar-iron.

Ba-rege'. (*Fabric.*) A French worsted dress goods, woven on a gauze or open taffeta loom, and having a cotton warp and an English wool weft. Usually printed.

Bar'-i-ron Test'er. A form of machine for testing bar-iron. See TESTING MACHINE.

Bark'ing Ma-chine'. Forsaith's barking machine for rossing logs for the making of wood pulp is an annular plate, set with plane bits, and revolving in a vertical plane.

"*Manufacturer and Builder*," * xii. 193.
Nomaison, Fr. . * "*Engineering*," xxii. 299.
Decorticator, Fr. * "*Scientific American Sup.*," 2478.

Bar'ley Fork. A four-pronged light-tined pitching fork, especially adapted for pitching unbound gavels of cut grain.

Bar'ley Hum'mel-er. A machine for taking the awns off the grains of barley.

Fig. 211.

Barley Hummeler.

The barrel is made of iron, and in it is a rapidly revolving spindle, furnished with knives so shaped as to feed the grain towards the exit.

Barm. Yeast. Sometimes used in the preparation of core-sand, to make it adhesive.

Barn-door' Hang'er. A suspending device for sliding-doors. See Fig. 1687, p. 721, "*Mech. Dict.*"

Anti-friction.
Brown & Curtis. . . * "*Iron Age*," xx. p. 9, July 26.

Barn-door' Rail. The rail on which the sheave of a barn-door traverses. See Fig. 1687, p. 721, "*Mech. Dict.*"

Bar Net. (*Fishing.*) The intercepting portion of a net set across a stream to direct fish into a wing pound. See STAKE-NET.

Ba-rom'e-ter. An instrument for determining the weight or pressure of the atmosphere.

In *Deschanel's* "*Natural Philosophy*," Part I., may be found illustrations of the following barometers on the pages noted. (American edition.)

Torricelli's	110	Sympiesometer . .	156
Fortin's	147	Aneroid	157
Tripod	149	Counterpoised . .	159
Siphon	154	*Fahrenheit's* . . .	160
Wheel	155		

The "Farmer's Weather-case," or Indicator, and direction for its use, furnished in the circular of the United States Meteorological Signal Office, is shown in "*Harper's Weekly*," supplement of September 21, 1878.

The following references may also be consulted: —

Green . . . . . * "*Manufacturer and Builder*," ix. 61.
Dalton . . . . . * "*Scientific American Sup.*," 742.
Glycerine, Kew . . * "*Scientific American*," xliii. 134.
Mariotti . . . . * "*Engineering*," xxiii. 314.
Optical . . . . . * "*Scientific American*," xxxiv. 148.
Redier . . . . . * "*Scientific American Sup.*," 574.
Registering, *Barnes* * "*Scientific American*," xxxiv. 308.
Water . . . . . * "*Manufacturer & Builder*," viii. 37.
Barometer and Thermometer combined.
* "*Scientific American*," xliii. 246.
Barometric Governor for Ventilating Fan.
* "*Engineering*," xxviii. 354.

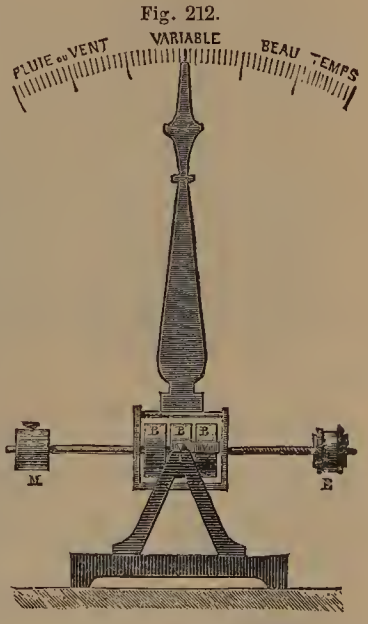
Works on the subject: —

Plympton's "*The Aneroid Barometer: Its Construction and Use.*"
Williamson "*On the Barometer.*"

Ba-rom'e-ter Flow'ers. Artificial flowers colored with chloride of cobalt. When exposed to sun and dry air the leaves become deep blue; when the air is saturated with moisture they become pinky. Intermediate shades are easily observed.

Ba-ro-met'ric Bal'ance. An invention of M. Redier, of Paris. It has a long index-needle having an arc of vibration of large amplitude, 30 to 60 centimeters, which makes it visible at a considerable distance.

Fig. 212.



Redier's Barometric Balance.

B B B are three aneroid barometer cases. To the first case to the left is attached a frame which

carries the counterpoises *M* and *E*. On the same frame is fixed the large index needle. The whole apparatus pivots on a knife blade, *T*, and the counterpoises *M* and *E* being movable, the apparatus can be balanced in such a way as to cause the index to point to any division desired. The cases are attached to a second frame, *V*. When the pressure increases, these cases are expanded and the two counterpoises move toward the right. The equilibrium is thus broken and the needle moves toward the same side. When the pressure diminishes the contrary effect is produced, and the needle moves to the left.

Ba'ro-mo'tor. A portable hand and foot power invented by Bozerain (France). It has two treadles connecting with cranks ou a fly shaft.

"*Manufacturer and Builder*," . . . * ix. 280.
"*Scientific American*" . . . . . * xxxvii. 242.

Bar'o-met'ro-graph. (*Add.*) *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877, article "*Météorographes*," Figs. 1–7, gives descriptions of those of —

* *Bréguet.* * *Gros-Claude.*
* *Hipp.* * *Secchi.*

Bar'on Steel. (*Metallurgy.*) Steel made by the Mackintosh process, for which "Baron" is an adopted name. See MACKINTOSH STEEL.

Bar'rage. A movable dam. Views of the barrages used in the river improvements betweeu Paris and Auxerre, and a description of the substitution of a continuous navigation upon the upper Seine and Yonne by the aid of movable dams, for the intermittent navigation by flashes, are to be found in the report of Dr. Watson, "*Civil Engineering, Public Works and Architecture;*" "*Vienna Exposition Reports*," vol. iii., section C, chapter V.

Poirée's movable dam or barrage, at Basseville, at the crossing of the Yonne over by the Nivernais canal, is shown in Plate IV.

"It consists of a succession of iron frames called *fermettes*, placed parallel with the current, and turning around their bases in bearings which are firmly attached to a carefully-prepared bed. The *fermettes* are united above by bars, having jaws or catches at their extremities. Against these *fermettes*, thus united, rests a screen, placed vertically, and composed of a number of wooden battens about 0.075 meters square and 2 meters long, called needles; the bottoms of these needles are placed against the sill, and their tops rest against the *fermette* bars placed near the level of the water, which the *barrage* is intended to maintain. Each *fermette* is trapezoidal; the two bases are horizontal. The lower base is terminated by gudgeons, which are received by two cast-iron bearings. The upper bases support a foot-bridge, used by the lock-keeper to work the *barrage*. The details of the hooks, bars, washers, etc., which serve to unite the *fermettes*, are shown in the lower portion of the plate. When it is required to open the *barrage*, the lock-keeper and his assistant remove the needles one by one; the bars, planks, hooks, etc., are removed, and the *fermettes*, turning on gudgeons at their bases, fall into a recess prepared for them below the level of the sill. When it is required to raise the *barrage*, the lock-keeper lifts the *fermettes* by grappling for them under the water, reconstructs his foot-bridge, and replaces the needles. The time required to raise the *fermettes* and place the needles, is about one and a half minutes per running meter; and the time to open the *barrage* thirty seconds; for the complete opening and lowering of the waters fifty seconds." — *Poirée.*

Formerly, during the low water season on the Yonne, the navigation was intermittent, and took place by a system of flashing, which may be thus described: In the upper parts of the river, the water was accumulated by movable dams; a part of one of these dams being suddenly removed, an artificial flood called an *éclusée*, or flash, was formed. Barges and rafts, previously collected above the dam, were carried by the flood down the river with a velocity of from 0.50 m. to 1.50 m. per second.

In Plate IV. the upper figure shows the plan of the crossing of the Yonne River by the Nivernais canal at Basseville.

Next beneath is an elevation of the Basseville barrage, showing half the barrage closed with the fermettes raised, and the other half closed with the fermettes lowered.

Next, a plan of the same.

Next, a transverse section on a much enlarged scale, showing the needle, the fermette and its bearings.

On the left, at the bottom of the plate, an elevation and plan of the details for uniting adjacent fermettes.

On the right, beneath, transverse section and plan of the gudgeons and bearings of a fermette.

Plate XIV. of Dr. Watson's report above cited, gives details and drawings of Chanoine's barrage dam at Port à l'Anglais, on the Seine, near Paris.

See also article "*Barrage*," vol. iv., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877.

Barrage, Godavery, India, * "*Engineering*," xxi. 340.
Barrage, Nile . . . . . * "*Engineering*," xxi. 40.
* "*Engineering*," xxi. 101, 143, 218, 245.

See, also, references under DAM.

Bar'rel. 1. A cask.

The following refereuces may be consulted: —

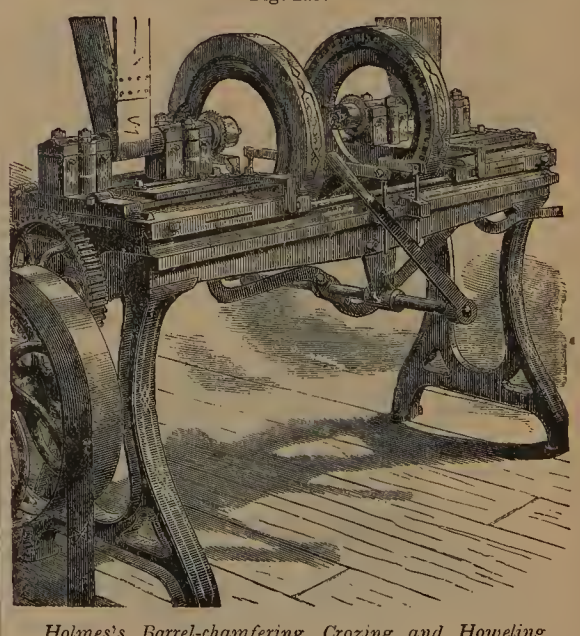
Barrel for shipping bottled liquors.
Strauss . . . . . * "*Scientific American*," xl. 103.
Barrel head making machine, Eng.
Worssam . . . . * "*Engineer*," xlviii. 397.
Barrel-hoop, corrugated.
Eiselein . . . . * "*Scientific American*," xli. 291.
Machine, *Holmes* . . * "*Engineer*," xli. 431.
Charring, *McNurtrie* . * "*Scientific American Sup.*," 1072.
Machine, *Monroe*. . . * "*Scientific American Sup.*," 1299.
Machine, Ger., *Guelph* * "*Engineer*," l. 266.
Machine, *Ransome* . * "*Engineering*," xxi. 453, 502, 547.
Barrel machinery, on. * "*Engineering*," xxi. 95.
Windlass, *Holmes* . . * "*Engineer*," xli. 431.
Cask washing machinery, Brewery (3 Figs.). Austria.
* "*Engineer*," iii. 404.

2. A description of the mode of manufacture and the proving of rifle barrels may be seen in "*Scientific American Supplement*," * 386.

Bar'rel Bolt. A form of door-bolt. One with a round bolt moving in a cylindrical case.

Bar'rel-bor'ing Ma-chine'. (*Fire-arms.*) A

Fig. 213.



Holmes's Barrel-chamfering, Crozing, and Howeling Machine.

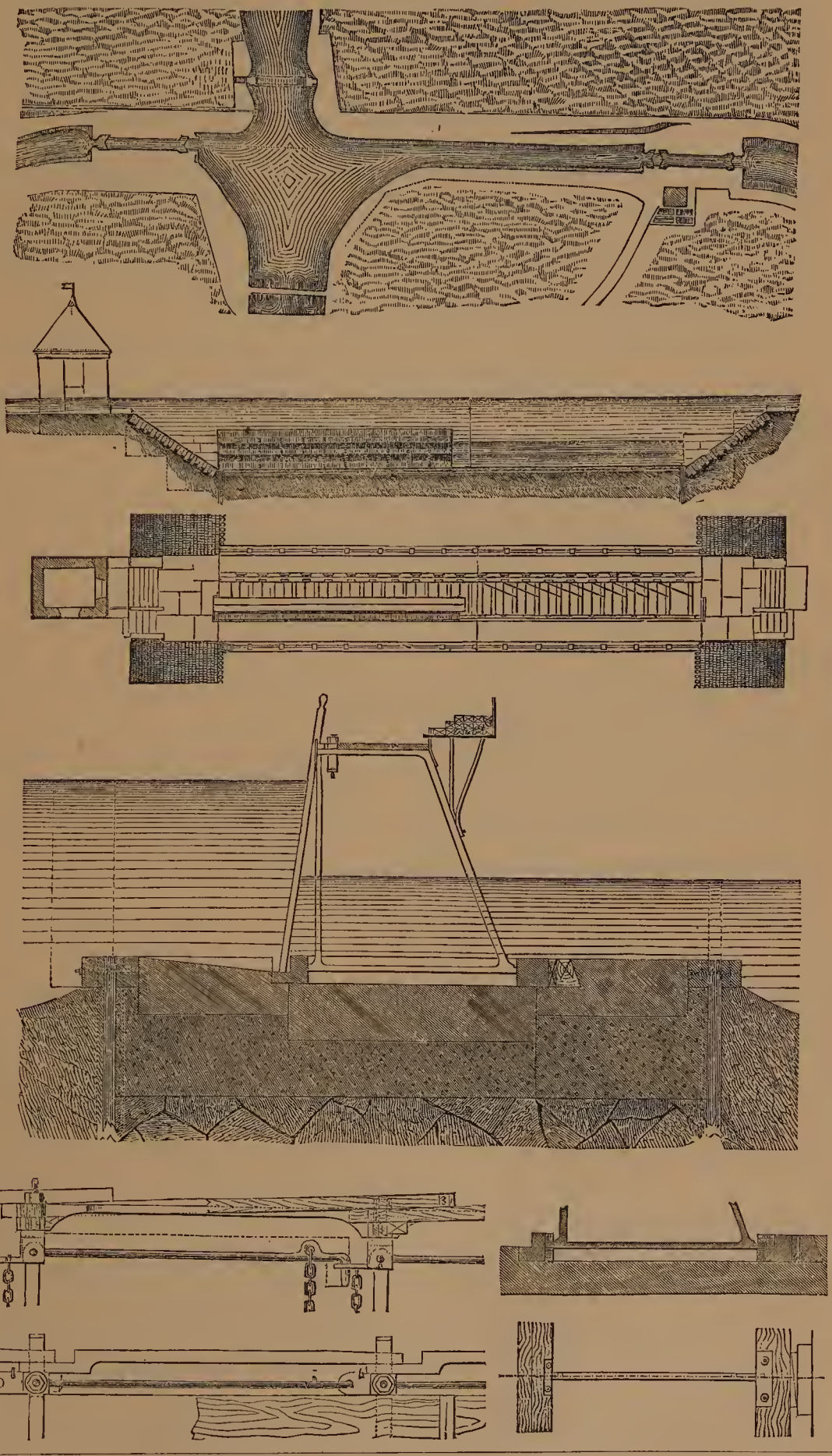


PLATE IV. POIRÉE'S BARRAGE, AT BASSEVILLE, RIVER YONNE, FRANCE. See p. 76.

lathe specially adapted to boring out gun-barrels. See RIFLING MACHINE.

Bar'rel-cham'fer-ing, etc., Ma-chine'. This machine is designed to chamfer, howel, level, and croze a cask of imperfect periphery, and to finish both ends of the cask at once. See Fig. 213.

To accomplish this, the three tools are placed in one revolving head, which, while revolving with high speed inside of the cask, is controlled by the rest upon the outside, compelling a uniform thickness and depth of chine, while it levels the same in a perfect manner; the rest and cutting head oscillating to conform to the outside irregular form of the cask while the latter makes one revolution; it having been placed within the chuck rings for that purpose.

All kinds of barrels, such as turpentine, oil, whiskey, pork, syrup, cement, sugar, flour, and other barrels, are made upon this machine, and it will finish any size desired by using the proper sized chuck rings. Rings for different sized barrels will fit the machine. The performance is 1,200 tight or 2,000 slack barrels per diem.

"*Engineer*," *xli. 431.

Bar'rel Clamp. A hoisting clutch or sling for barrels. The Yale barrel-clamp, "*American Miller*," vii. 275.

Bar'rel Cock. A faucet. The one shown is for racking, or drawing off the contents by pipe, the outer end of the faucet having a screw coupling.

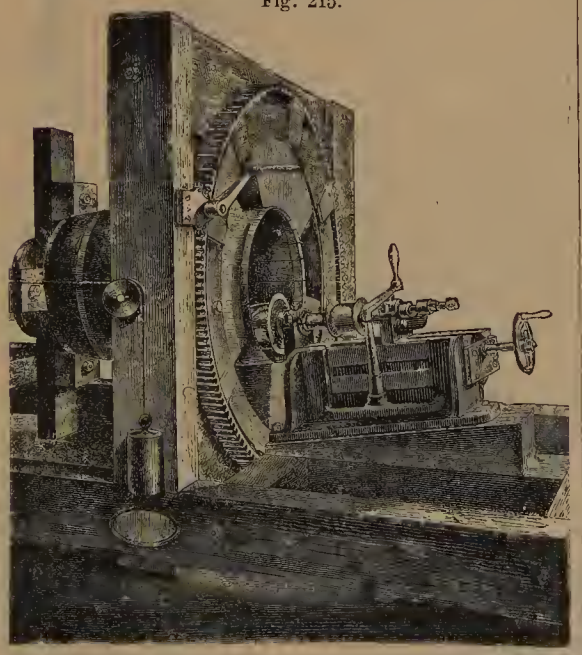
Fig. 214.

Barrel Cock, with coupling.

Bar'rel-cro'zing Ma-chine'. A machine for making the *croze* in the heads of casks. The *croze* is the groove in which the edge of the head is inserted and held. See BARREL-CHAMFERING MACHINE.

Bar'rel-fa'cing, Cro'zing, and Cham'fering Ma-chine'. A machine for dressing the ends of casks, and making the head croze.

Fig. 215.

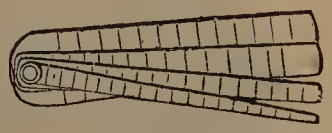


Barrel-facing, Crozing, and Chamfering Machine.

The machine shown is that of Arbey, of Paris. The cask is chucked in a revolving head, and each portion of the end circumference brought in turn against a rotating tool which planes and rounds the interior near the end, makes the croze groove, and chamfers the chine. The tool has all the requisite longitudinal and lateral adjustments.

Bar'rel Gage. A gage for testing the diameter of gun-barrels according to a standard; the instrument has several tapered slips, each graduated, and having a certain range of sizes, the diameter of the barrel being determined by slipping the gage into the muzzle.

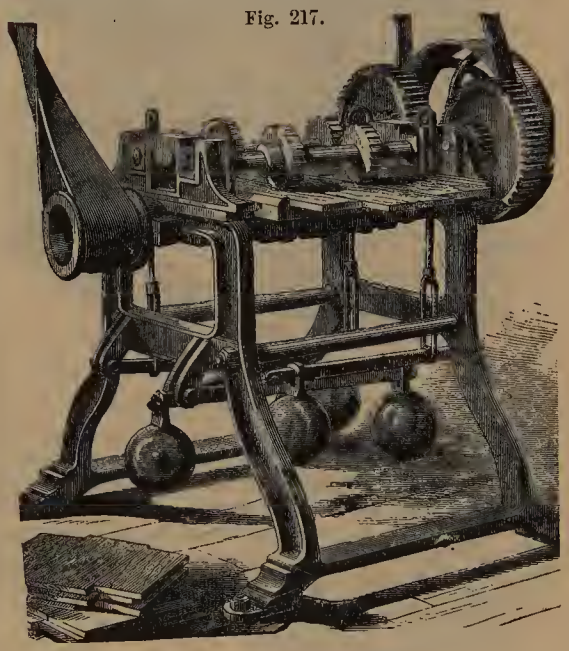
Fig. 216.



Gun-barrel Gage.

Bar'rel-head Dress'ing Ma-chine'. A machine for leveling, facing and dressing on one side the rough barrel-head, made of staves doweled together.

Fig. 217.



Barrel-head Dressing Machine.

The prepared head is laid on the table, is fed by four corrugated feed-rolls above, and its under side dressed by a planer cylinder rotated by a belt shown on the left hand. The pulleys on the right actuate the feed-rolls, which are held against the head by weighted levers acting upon the bearings. The revolution of the feed-rolls carries the head over the planer knives which smooth off the heads at the rate of 20 per minute, feeding rapidly in succession.

Bar'rel-head Joint'ing and Dow'el-ing Ma-chine'. A machine which dresses the edges of staves for heads, and bores the holes for the dowel-pins which hold the head-staves together.

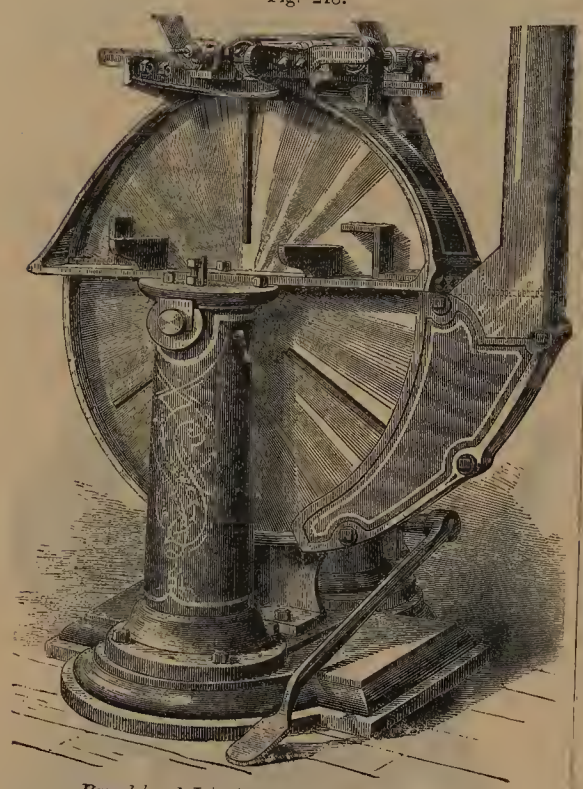
The machine, Fig. 218, has a metallic disk with three radial cutters which act upon the edge of a stave presented to them while lying upon the side-rest diametrically of the rotating disk.

The stave is then removed to the upper rest, and the two rotating augers which bore the dowel-holes are brought against it by pressing the foot upon the treadle.

Bar'rel-head Round'er. A machine (Fig. 219) which works upon the head-blank, rounding it and beveling the edge to fit the croze of the cask.

The head-staves, being jointed and doweled to-

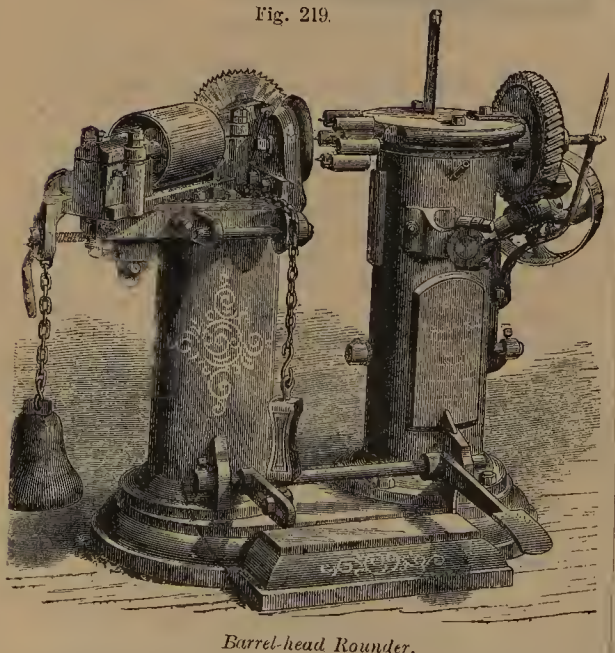
Fig. 218.



Barrel-head Jointing and Doweling Machine.

gether, are placed between the two clamps, one of which is on each side of the posts, so that the head, being in a vertical plane, revolves between them. This clamping is done by treadle, the head with pins being made to approach the round disk on the left. A circular saw brings the head to a round shape, and cutters chamfer the edge. This machine follows Fig. 217, the head dresser.

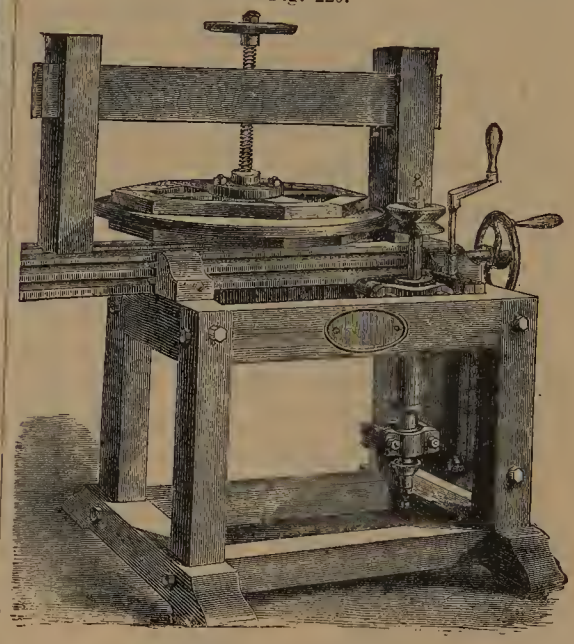
Fig. 219.



Barrel-head Rounder.

Bar'rel-head Turn'ing and Bev'el-ing Machine'. Fig. 220 is a French machine for this purpose, made by Arbey of Paris. The head is carried in a frame, which has a horizontal adjustment to bring it in relation to the concave-faced revolving cutter, and is rotated, to bring each part of its periphery to the tool.

Fig. 220.



Arbey's Barrel-head Turner.

Bar'rel Hooks. Suspension hooks in pairs, for hoisting casks by the chines.

Fig. 221.

Barrel Hooks.

Bar'rel Lev'el-ing Machine'. A machine (Fig. 223) which brings the end of a cask or barrel to a level, that is, to a plane at right angles to the axis of the cask, so that it will stand squarely and vertically upon the floor.

Two end truss hoops are put on to the cask, which is then rolled into the press, the power applied, and the movable disk driven up against one end of it, bringing it into shape, leveling it and driving the truss hoops in an instant.

The machine has an iron frame, upon which are placed two leveling plates upon slides or guides, and operated by cams. Two other plates or slides are worked by cranks. Upon the latter are hoop-drivers. The leveling plates are first moved by their cams, and then, while the cask is in shape, the hoop drivers advance and force all the truss-hoops to their places. The leveling plates and drivers then recede, and one barrel is discharged from the machine by the introduction of another. The capacity is from 4,000 to 5,000 barrels per day.

Fig. 222.

Barrel Lifter

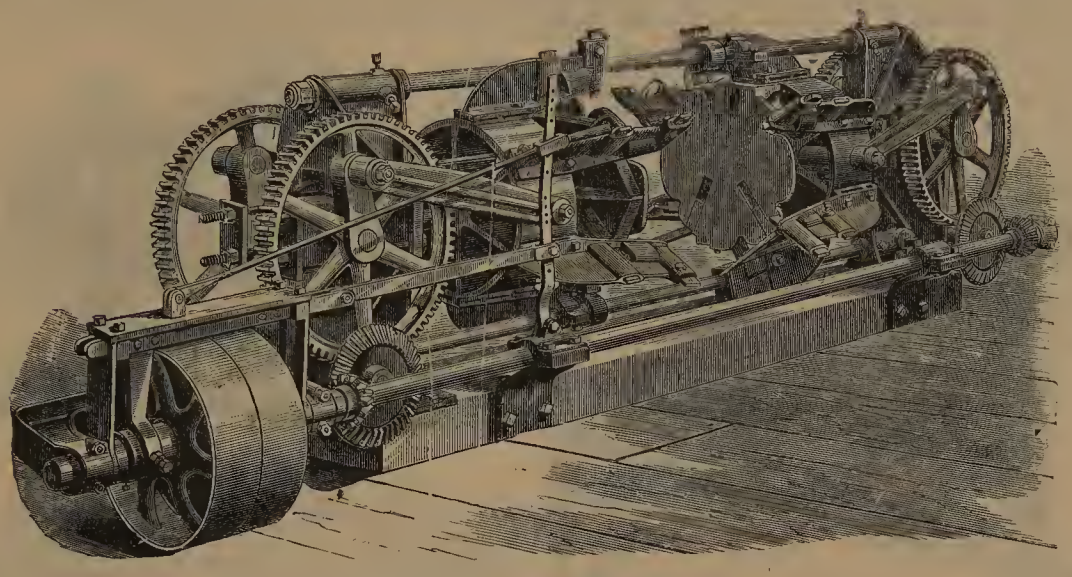
Bar'rel Lift'er. 1. A handled hook for lifting a cask by the chine. Used in warehouses, and for stowing away barrels and kegs in holds of vessels.

2. In another sense: an apparatus for hoisting barrels.

Brown . . . . "*Scientific American*," xli. 327.
German . . . . "*Scientific American Supplement*," 731.

Bar'rel Mak'ing Ma-chin'e-ry. Machines for making hogsheads, casks, barrels, and kegs, are

Fig. 223.



Holmes's Barrel Leveling Machine.

classed by size, by their nature, whether for *tight* or *slack* work, and whether for working on staves for sides or heads, for working on hoops of wood or iron, for putting up and finishing, etc.

Stave Machinery: —
Stave riving and sawing machines.
Dressing rived or sawed staves.
Stave jointing and listing.
Stave equalizer.
Stave saw.
Head Machinery: —
Heading saw.
Head turning machines.
Head dressing and leveling machines.
Heading jointing and doweling.
Head rounding machines.
Hoop Machinery: —
For punching, flaring, and riveting iron hoops.
For bending and rendering flexible wooden hoops.
Barrel Machinery: —
Power windlass, for putting up.
Chamfering, howeling, and crozing machines.
Leveling and trussing machines.
Truss-hoop driving machine.
Turning and smoothing machine.
Setting-up forms.
Barrel elevators.
Barrel heaters.

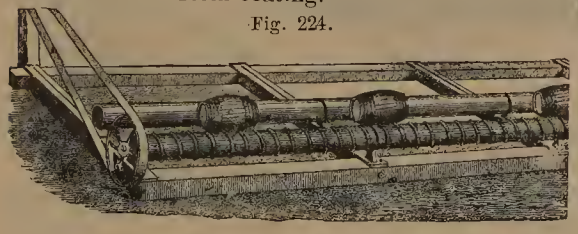
See under the various heads and in "*Mech. Dict.*"

Bar'rel Pitch'ing Ap'pa-ra'tus. An apparatus for pitching the interior of casks.

The machine (Fig. 224) is provided with two lines of rollers, one of which has a screw thread upon its periphery which imparts a lateral as well as rotary motion to the cask, which is placed upon and between the two rollers, and thus passed from one end of the machine to the other, the liquid pitch being distributed over its whole interior.

In Vollmer's apparatus for pitching barrels, the pitching material is placed in the barrel, which is made to rotate; a blast of hot air being forced in melts the pitch, and spreaders give to the inside of the barrel a uniform coating.

Fig. 224.



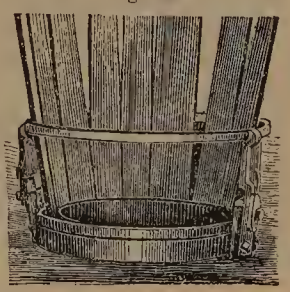
Brenner's Barrel Pitching Machine.

Bar'rel Saw. An annular or cylindrical saw for curved work.

See *Avrillon*, 2d Series French *Brevets*, vol. xxiv., pl. 2.

Bar'rel Set'ting-up' Form. An annular tray and elevated hoop for holding a set of staves while being placed in position to form a cask, shown in Fig. 225. The form is made adjustable, to suit the size and kind of barrel.

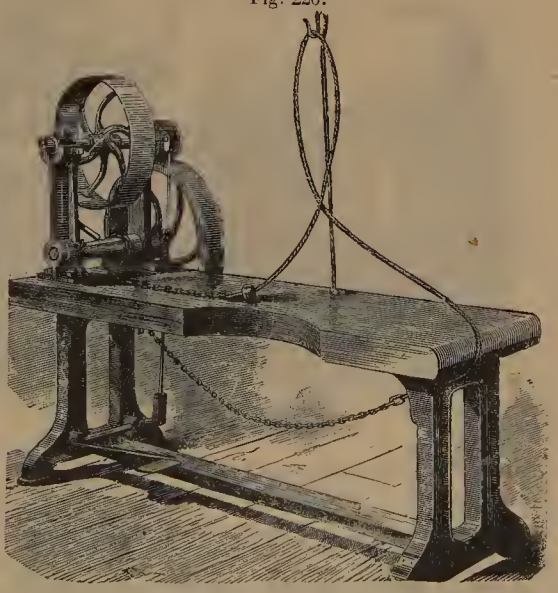
Fig. 225.



Setting-up Form.

Bar'rel Set'ting-up' Ma-chine'. A machine (Fig. 226) by which the ends of staves are drawn together, ready to receive the head truss-hoop, after they have been set up in the setting-up form, Fig. 225.

Fig. 226.



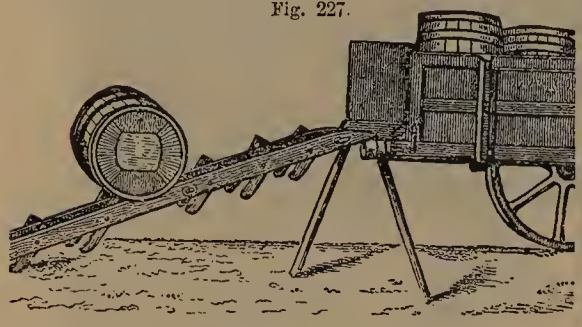
Power Windlass for Setting up Casks.

The machine has a frame, upon which is planted a windlass operated by friction wheels and supplied with a rope.

The cask, having been set up with the ends of the staves in one head truss-hoop, is placed in the machine, and the rope wound around the flaring ends of the staves. The friction wheels are brought in contact, which starts the windlass and draws in the ends of the staves ready to receive the other truss-hoop.

Bar'rel Skid. Fig. 227 shows a skid with pawls, which yield to the pressure of the cask in ascending, but oppose its return. The pivoted stops swing in one direction, but are locked in the other.

Fig. 227.

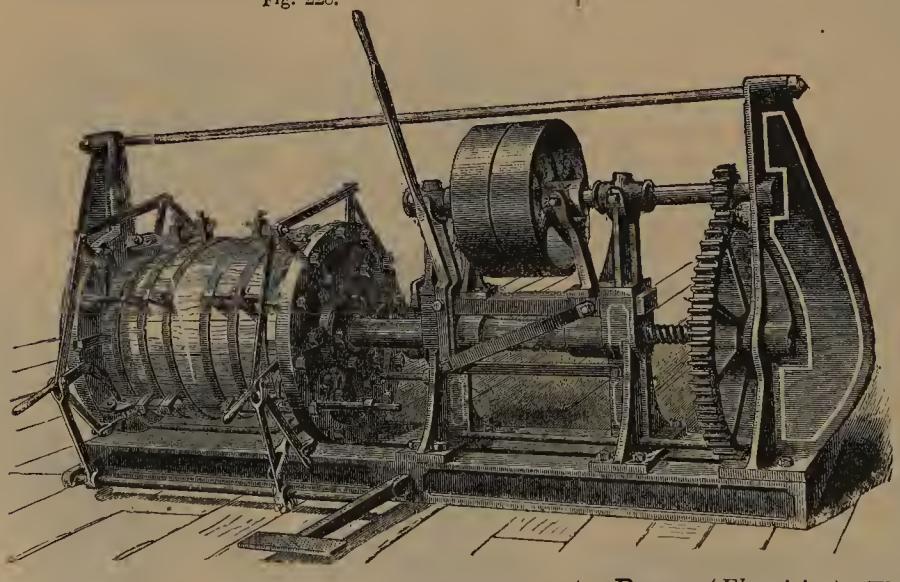


German Barrel-skid.

Bar'rel Stand. See CASK STAND.

Bar'rel Truss'ing Ma-chine.' A machine (Fig. 228) for operating upon slack barrels; compressing a barrel endwise to make it symmetrical and enable it to stand vertically when placed upon end, at the same time driving all the truss-hoops. The machine receives the barrel with all the truss-hoops upon it, but not driven; by placing the foot on the treadle and the hand on the lever, the machine being in motion, the drivers are brought in contact with all the truss-hoops, forcing them to their proper places and at the same time leveling the cask.

Fig. 228.

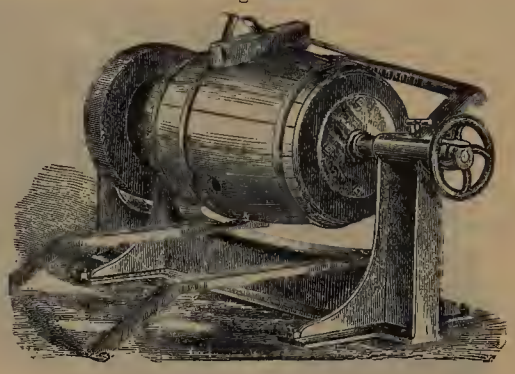


Combined Leveling and Truss-hoop Driving Machine for Slack Barrels.

Bar'rel Turn'ing Lathe. (*Fire Arms.*) See MILLING MACHINE.

Bar'rel Turn'ing Ma-chine'. A machine (Fig. 229) in which a barrel is chucked and revolved while the plane is kept in line by the back arm of the machine, the operator having only to guide it.

Fig. 229.



Barrel Turning Machine.

Bar'rel Wash'er. The barrel is placed on four adjustable supports and rinsed by jets of water from the pipe extending in at the bung-hole. (Fig. 230.) It is so arranged that when the barrel is placed on the supports the water-supply valve is opened; and is closed by means of a spring when the barrel is removed.

A more pretentious machine is that shown in Fig. 231, in which each barrel receives two motions, one on the axis of the chucks which hold it, and the other by the revolution in a vertical plane of the whole frame in which the barrels are held. The former motion throws the water from end to end and the latter from bilge to bilge.

Bar'ri-er. (*Mining.*) A strong pillar of mineral left between two mines, or between two distinct drifts or workings.

Bar'row. See —

Baggage barrow.
Baggage truck.
Bloom truck.
Box barrow.
Carboy barrow.
Coke barrow.
Dumping barrow.
Pump barrow.
Railway barrow.
Sack truck.
Stone truck.
Tub barrow.

See 24 varieties of French wheelbarrows in "*Scientific American Supplement*," * 2622–24.

Bar'row-way. (*Mining.*) An old term for a way in a working. Now *tram-way*.

Bar Shear. A heavy shearing machine for cutting bar iron.

Bar Weir. (*Fishing.*) A weir which is raised as the tide flows into a pond, estuary, or inclosed space; and drops automatically when the tide commences to ebb, thus preventing the return seaward of the fish.

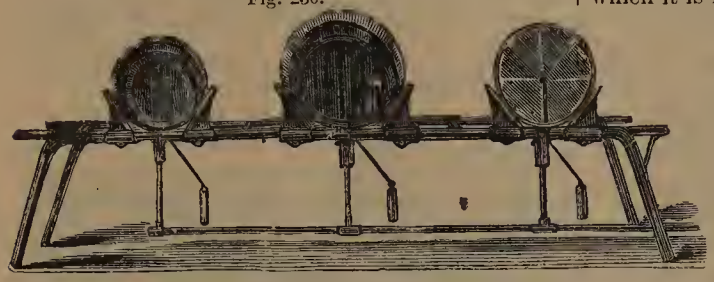
Base. (*Electricity.*) The part of an electro-magnetic instrument containing the helix, switch, primary and secondary binding posts, etc.

Base'-line In'stru-ments. For the measurement of the foundation line of a trigonometrical survey.

See p. 2461, "*Mech. Dict.*," and "*Report of Secretary of War*," 1878, vol ii., Part III., p. 1401, *et seq.*, and Fig. 4.

Base Rock'er. A chair which rocks upon a base piece, having supporting casters.

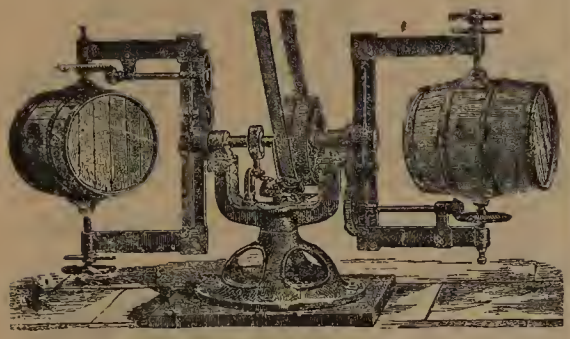
Fig. 230.



Zoller's Machine for Washing (Rinsing) Kegs.

Bas'ic Lin'ing. As applied in convertors or boshes of metallurgic furnaces; a lining which has a tendency to absorb the phosphorus present in the iron.

Fig. 231.



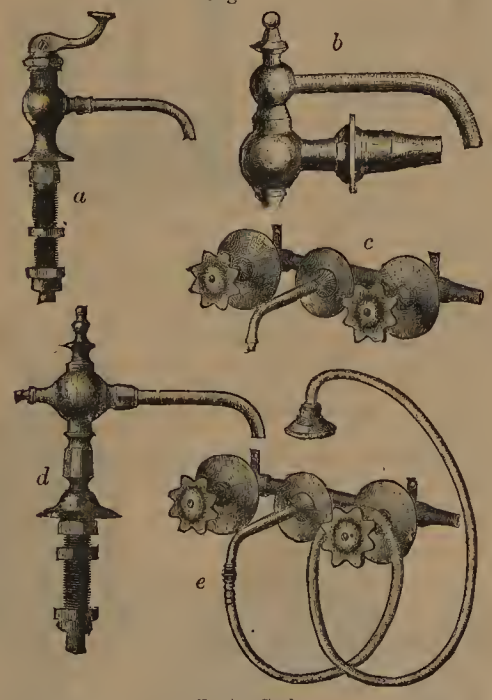
Barrel Washer.

In the Thomas furnace a basic calcareous or magnesian lining is used in the convertor, and lime, or lime and oxide of iron, is added to the charge of metal to insure a highly basic and calcareous slag, in which phosphorus is retained and by which it is removed.

Jacob Reese's Patent, 1866.

Thomas's British Patent, and United States Patent 216,910, June 24, 1879.

Fig. 232.



Basin Cocks.

a. Telegraph basin-cock; on account of the shape of the trigger, resembling the key of the telegraph instrument.
b. Bracket basin-cock.
c. Combination basin-cock; for hot and cold water.
d. Ground basin-cock.
e. Combination basin-cock, with rubber tube and sprinkler, for shower-bath or shampooing.

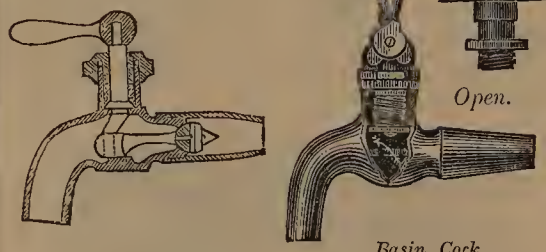
Ba'sin Cock. A faucet to a wash-basin. See Fig. 232.

Fig. 233.

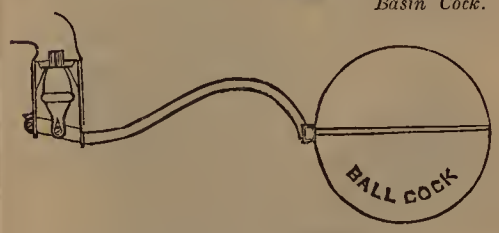
Fig. 233 shows the positive self-closing cock, which has a spring to force the disk on to its seat, and is removable by pressing together the two horns. The pressure withdrawn, the spring reecloses the valve-way.

Fig. 234 shows the Fuller-Meyer basin cock, in which a conoidal plug of caoutchouc is forced into a conical opening while the pressure of the water tends to confirm the joint. Fig. 234 also shows a Fuller-Meyer ball cock, similar to the basin cock in the special feature mentioned.

Fig. 234.

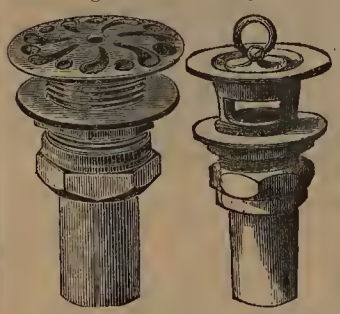


Basin Cock.



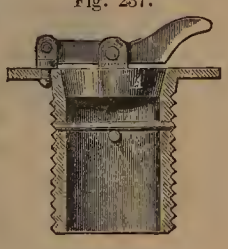
Basin Cock and Ball Cock.

Fig. 235. Fig. 236.



Basin Grate. *Basin Plug.*

Fig. 237.



Basin Stopper.

Ba'sin Grate. A grated opening to the waste-pipe of a basin or bath-tub, opened by screwing up, and closed by the reverse motion. Fig. 235.

Ba'sin Plug. The stopper of a standing wash-bowl. Fig. 236.

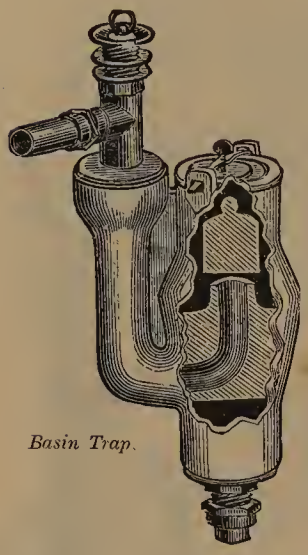
Ba'sin Stop'-per. A plug, Fig. 237, for the waste-pipe of a standing wash-bowl.

Ba'sin Trap. A seal against sewer-gas in the waste-way of a standing wash-bowl.

The arrangement shown in Fig. 238 excludes sewer-gas, whether water is in the trap or not, —

the porcelain valve seating itself upon the upturned end of the pipe.

Fig. 238.



Basin Trap.

Ba'sin Valve. A plug for the aperture at the bottom of a standing wash-basin.

See BASIN STOPPER.

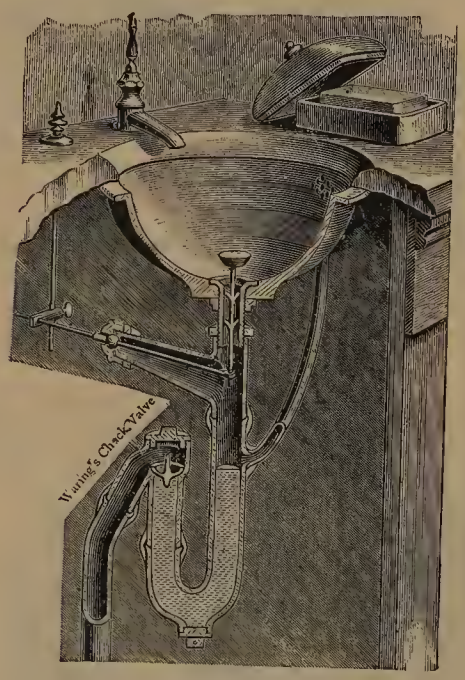
Ba'sin Waste. A pipe at the bottom of a standing wash-basin for the discharge of water. Stopped by a valve.

Fig. 239 is a substitute for the usual chain and plug for stopping the waste of wash-basins. Touching the knob on one side of the bowl opens or closes the valve.

The figure also shows a trap provided with check-valve to prevent passage of sewer-gas.

Ba'sin Wrench. A plumber's wrench with the nipper-jaws presented lateraliy to enable screws, nuts, and collars to be reached in peculiar situations.

Fig. 239.



Weaver's Basin Waste.

Bas'ket. (*Add.*) 2. (*Fabric.*) An all-wool fancy French coating.

Fig. 240.

Basin Wrench.

Bas'ket-rack. (*Railway.*) A receptacle in a passenger car for holding baskets, shawls, etc.

Bass Clar'i-net. (*Music.*) An instrument an octave below the clarinet, in B flat.

Bas'si-net. (*Fr., dim. of bassin.*) A light basin-shaped helmet without a vizor.

Bas'son-Quinte. (*Music.*) A double-reed instrument, the diminutive of the bassoon, its pitch being one fifth higher.

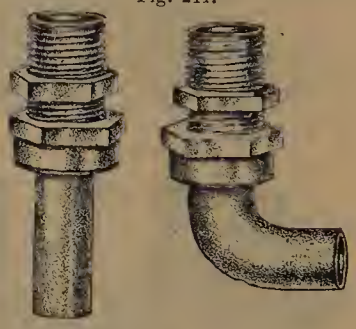
Ba-ta'vi-a Weave. (*Weaving.*) See TWILLED ARMURE.

Bath. 1. For bathing the person. See p. 246, "*Mech. Dict.*"

Arrangement of building for Turkish baths. * "*Manufacturer and Builder*," ix. 184.
Swimming Bath, London. * "*Scientific American Supplement*," 1348.
Roman Bath. * "*Plumber and Sanitary Engineer*," ii. 67.

2. Used in laboratories and factories for heating the objects plunged therein. The reservoir may be a sand-bath, water-bath, oil-bath, mercury-bath, lead-bath, bain-marie, etc., according to circumstances.

Fig. 241.

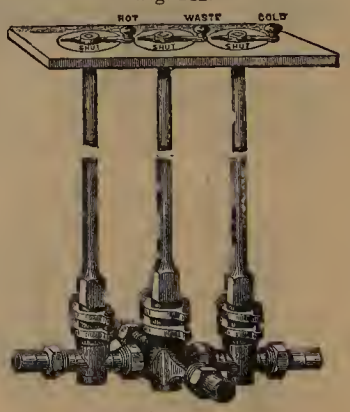


Bath-boiler Union.

Bath'-boil'er Un'ion. A coupling in the pipe uniting the boiler and the bath reservoir. It is made straight or goose-neck, according to convenience.

Bath Cock. A faucet for bath use. In superior instances the arrangement has separate cocks for hot and cold water, and waste, with engraved labels. The cocks have gun-metal stuffing boxes, brass levers, union-joints, the water cock 1″ diameter, and the waste $1\frac{1}{4}$″.

Fig. 242.



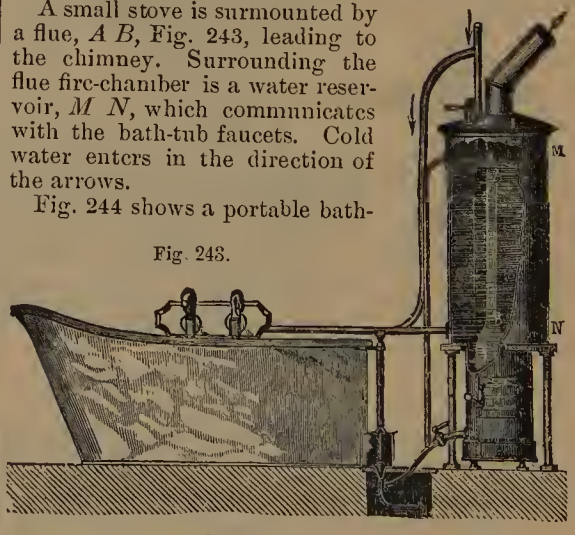
Bath Cocks.

Bath Heat'er. A special arrangement for heating baths, when it is not convenient to connect it to the usual house service of hot and cold water.

A small stove is surmounted by a flue, *A B*, Fig. 243, leading to the chimney. Surrounding the flue fire-chamber is a water reservoir, *M N*, which communicates with the bath-tub faucets. Cold water enters in the direction of the arrows.

Fig. 244 shows a portable bath-

Fig. 243.



Stove Bath-heater.

tub heated by gas, which requires but an elastic tubular connection with a burner in the room. A ring of gas-jets burns beneath the tub, and at the foot end the exhaust gases pass out at a grated opening.

Bath heater. "*Manufacturer & Builder*," viii. 43.

Fig. 244.

Gas Bath-heater.

Bath'ing Car. A car fitted up to contain the apparatus of a Turkish bath. The invention of C. H. Cooper.

The internal arrangement is a parlor or drawing-room, 10′ by 15′; Russian and plunge bath, 8′ by 7½′; three shampooing rooms, 6′ by 7½′; tepidarium, 10′ by 23′; movable closets, 2½′ by 10′; passages 18″ wide. The temperature in the various rooms will vary from 80° to 160°. The whole is lighted by blue glass. The car may be used on trains or side-tracked at towns where no such establishments are in operation.

Bath-om'e-ter. The name given by Dr. C. W. Siemens to his instrument for sounding the depth of the sea without the use of a line. The principle upon which the action of this instrument depends is the diminution of the influence of gravitation upon a weighty body, produced by a decrease in the density of the strata immediately below it; thus the density of sea-water being about 1.026 and that of the solid constituents which form the crust of the earth about 2.75, it follows that an intervening depth of sea-water must exercise a sensible influence upon total gravitation if measured on the surface of the sea.

"*Engineering*" . . . . . * xxi. 260
"*Scientific American Supplement*," * 368.
"*Scientific American*" . . . . * xxxiv. 231.
Laboulaye's "*Dictionnaire des Arts et Manufactures*," iii., article "*Sondage à la Mer.*"
Fol's Bathometer, *"*Scientific American*," * xxxvi. 260.

See also Sounding Apparatus, p. 2247, *et seq.*, "*Mech. Dict.*"

See also Flying Sounder, *infra*.

Bath Stove. A stove with circulating pipes connecting with and designed to heat a bath. See Bath Heater.

Bath Tub. Fig. 245 shows a tub of flexible

Fig. 245.

Portable Bath Tub.

material with braces sufficiently strong to preserve the outline of the upper edge of the tub when arranged for use, but sufficiently flexible to admit of their being bent so as to be inclosed in the tub when it is folded. There are also vertical props for supporting the sides and an air-cushion for the head.

Bath'-tub Strain'er. A perforated plug or plug-cover in the waste of a bath to keep soap, linen, or what not from entering the waste-pipe.

Ba'ting. (*Tanning.*) Steeping hides in a lixivium of hen manure, after coming out of the lime-vats.

The process tends to separate the lime, oil, and glutinous principle, and to make the skins pliant, porous, and ready to imbibe the tanning principle.

Ba'tiste. A fine, thin French cassimere made for use in tropical countries in place of cotton and linen fabrics.

Ba-to're-om'e-ter. An instrument invented by Professor Giordano of Naples, for measuring minute variations of thickness, as, for instance, the increased thickness of a pane of glass due to heat derived from a finger resting upon it.

A vertical tripod is traversed by a very fine micrometer screw, and surmounted by a dial, the border of which is marked off into divisions according to a certain scale.

The object is laid upon the table and the micrometer screw caused to approach it. As soon as contact takes place an electric current, shown by a galvanometer, passes between the point of the screw and the table. If the object to be measured be a poor conductor, it is coated with gold-leaf.

Bat Print'ing. (*Ceramics.*) An adaptation of the transfer-printing process as applied to pottery.

An impression in glue (instead of ink) from a copper plate, is transferred to the biscuit, and on this viscous surface metallic color in powder is dusted. The ware is subsequently glazed and baked.

Bat'te-ry. (*Electricity.*) An electro-magnetic instrument taken as a whole.

The part of the machine composed of the jars containing the plates and exciting fluids.

See Galvanic Battery; and list under Electrical Apparatus.

(*Naval.*) See Iron-clad, Armor, etc.

Stevens's Battery, "*Iron Age*," xix., April 19, p. 1.

(*Military.*) See Battery Gun, Machine Gun, "*Mech. Dict.*"

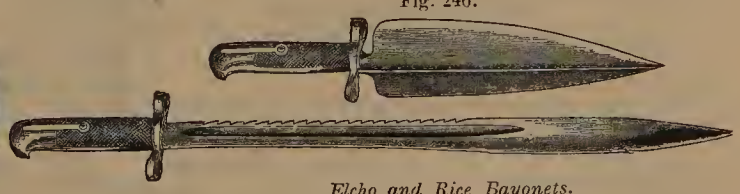
(*Mining.*) An embankment.

Bat'tle-dore. (*Glass-making.*) The wooden paddle used in shaping articles while blowing. For instance, it is held against the inside of a tumbler to render it circular in shape while the article is revolved.

Bau'de-kin. (*Fabric.*) An English brocade. Name derived from Baldachini, from Bandas, Baldac, *i. e.*, Baghdad. From the use of the stuff in canopies, the word has been transferred to the latter. — Col. Yule's "*Marco Polo.*"

Bay'o-net. The Rice trowel-bayonet, the invention of Col. Edmund Rice, and the Elcho saw bayonet, invention of Lord Elcho, are shown in

Fig. 246.



Elcho and Rice Bayonets.

Fig. 246. It has been proposed to issue them in certain proportions to troops. See "*Ordnance Report*," 1872, 1873.

The Snider bayonets for the British Government, triangular in section, are forged from 1 1/16″ round steel bar, which is drawn down under a power ham-

mer, about 4″ remaining untouched to form the socket. The bar is next bent or "broken down," as the term is, in two places. After being cut off from the bar, sufficient metal being left for the blade, it is stamped in a pair of dies; the blade is then drawn out by the hammer. The rolling is performed by Barnes' patent rolling machines, in which there are two horizontal spindles, each carrying four cams, in which the dies are fixed. These cams occupy about one third of a circle; and the dies, which are cut on the periphery, are set so as to give the required thickness to the bayonet blade. After the bayonet has been trimmed, it is hardened and ground. The socket is next drilled and milled, the slot for forming the attachment to the rifle being afterwards cut; and after the further operation of "blueing" and polishing, the bayonet is complete.

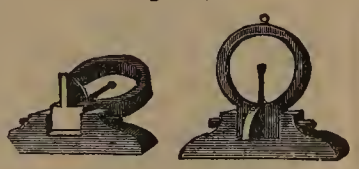
See also "*Ordnance Report*," 1877, appendix L, p. 565, and Fig. 99.

Bay'on-et-tooth For'ceps. (*Surgical.*) A tooth forceps, the prongs of which are set off from the side though parallel with the general trend of the instrument, in a manner similar to the position of the bayonet relatively to the barrel of the musket.

Bay Win'dow. A projecting window with angular corners. A compass window.

Beach Com'bi-na'tion Sight. A sight for near or distant shooting: in the former case with the globe down, exposing the fin; and for distance, with the globe and its protecting ring erected.

Fig. 247.



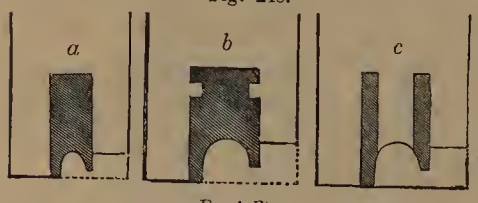
(As Open.) (As Globe.)

Beach Combination Sight.

Bea'con. A mode of illuminating sea beacons by gas from a position on shore is described in a paper by *J. Wigham*, "*British Association*," Mechanical Section, 1878. "*New Applications of Gas for Lighthouses.*" Reported in "*Scientific American Supplement*," * 2339.

A small light is kept by day by means of a by-pass connection, and full gas turned on at night.

Fig. 248.



Bead Planes.

(*a.*) Full boxed bead. (*b.*) Dovetail boxed bead. (*c.*) Double-boxed bead.

Bead. 1. (*Planes.*) An inserted guide in the sole of a molding plane. Fig. 248.

2. (*Glass.*) Glass beads are made from glass tubes.

See also BEAD, BEAD-FURNACE, pp. 253, 254, "*Mech. Dict.*"

3. (*Architecture.*) Globular ornaments carved on moldings.

Bead'er. (*Sheet-metal Working.*) A machine for making beads on round boxes, such as blacking boxes, for instance.

Bead Sight. (*Rifles.*) One form of sight; a small circular object elevated on a thin stem and placed in the line of sight. Also called *pin-ball* sight.

An *open bead* has a circular opening through a bead somewhat larger than a solid one. Also called *Aperture* sight.

Fig. 249.

Bead. *Open Bead.*

Combined sometimes with a *bar*. See BAR AND BEAD SIGHT.

Beam. 1. Curved wooden beams are of four kinds: *scarfed, bent, flitched, laminated*, which see.

See also pp. 254-257, "*Mech. Dict.*"

Curved beam. * "*Scientific American Supplement*," 2035.

2. A weighing scale, or the main member of a lever scale.

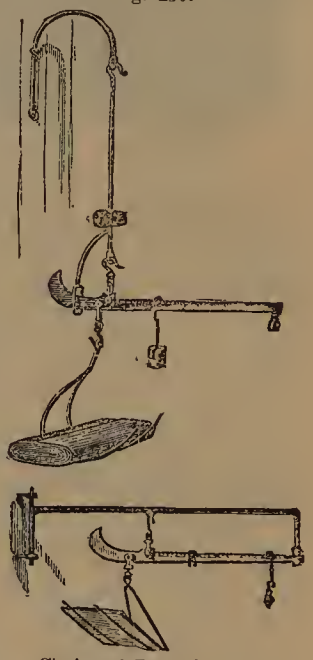
An *even-beam;* one hung by the middle, as in the regular balance.

A *cloth-beam* is for determining the weight per yard by weighing the piece of cloth.

A *paper-beam* is for determining the number of pounds to the ream by weighing one sheet of paper.

A *cotton-beam* (Fig. 251) is for weighing bales. All these are applications of the *Statera*, the *balance-Romaine*.

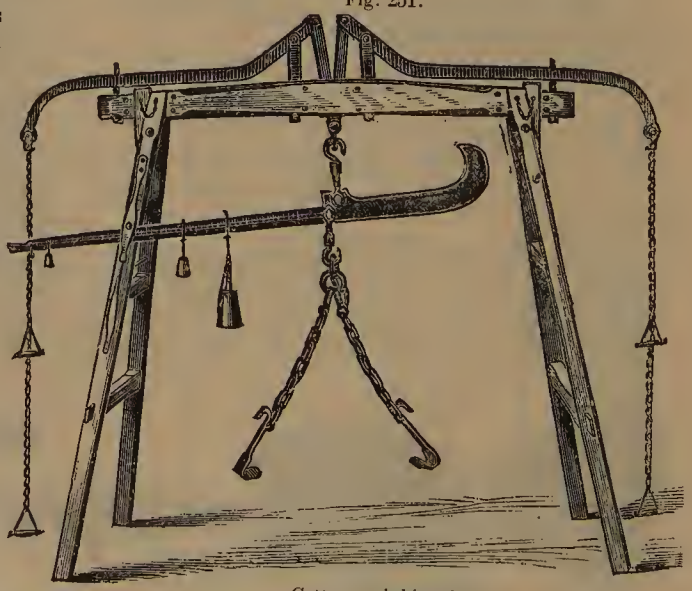
Fig. 250.



Cloth and Paper Beams.

3. (*Leather.*) An inclined block at which a currier stands to shave the leather with a knife, which agrees in the shape of its edge with the plate of mahogany or *lignum vitæ* which forms the face of the beam.

Fig. 251.



Cotton-weighing Beam.

Beam Com'pass. Suggested forms: —

"*Scientific American Supplement*,"	* 315.
"*Railroad Gazette*"	* viii. 212.
"*Engineering*"	* xxi. 139.

Beam En'gine. See the following references:

Beam Engine.

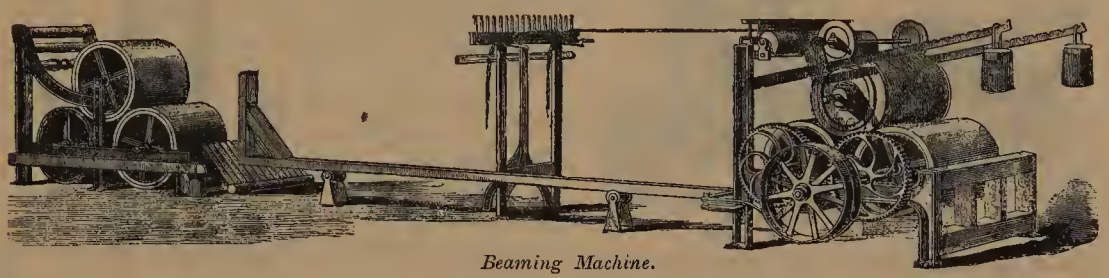
Chickering Factory. . . .	*"*Sc. Amer.*," xxxix. 255.
Corliss, Phila., 1876 . . .	*"*Engineer*," xli. 413.
	*"*Engineering*," xxi. 413.
(France).	*"*Sc. Amer. Sup.*," 2829.
Heslop, 1790, Br.	*"*Engineer*," xlvii. 69.
	*"*Engineering*," xxvii. 101.
Thomas & Powell, Fr. . .	*"*Engineering*," xxvii. 50.
Windsor, Fr.	"*Engineer*," xlvii. 99.
La Concorde Mine, Belg. .	*"*Engineer*," xlvii. 190.

Beam'er. A beaming machine.

Beam'ing Ma-chine'. One for filling yarn beams of looms. Fig. 252.

Rosseter's self-stopping beaming mill (British) is described and shown in the "*Textile Manufacturer*," 1878, and reproduced in "*Scientific American Supplement*," * p. 1938.

Fig. 252.



Beaming Machine.

attention to the fact that the bearing has become heated.

"*Engineering*," * xix. 120; * xxi. 96.

Beat'ing Ham'mer. (*Bookbinding.*) A hammer with two round faces; used in condensing and shaping backs of books in the process of binding.

Fig. 253.

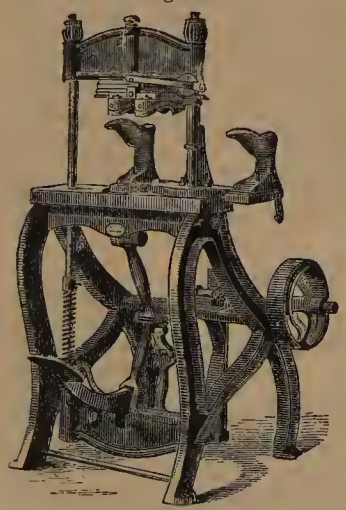
Beating Hammer.

Beat'ing-out' Ma-chine'. A machine for shaping shoe-soles which are presented on a last to a form above, being lifted by a toggle, operated by foot or by power. Fig. 254. It is a machine forming a substitute for the hammer.

Beat'-away. (*Mining.*) To excavate. Usually applied to hard ground.

Beat'er. (*Add.*) 6. (*Mining.*) An instrument for packing stemming on a charge of powder in a blast-hole.

Fig. 254.



"*American*" *Beating-out Machine.*

Fig. 255.

Becket Block.

Beck'et Block. A tackle-block with a becket beneath to which a rope may be bent. Fig. 255.

Bean Mill. A mill used in Britain for crushing beans for horse-feed, and known there as a *kibbler*.

Bidwell's has triangular blades placed around the circumference of two lateral disks.

Bean Sli'cer. An invention of A. Bens, Deventer, Netherlands. A machine for slicing French beans.

Bear'er Bar. A bar in a furnace beneath and supporting the grate bars.

Bear'ing Feel'er. An arrangement invented by Alley of Glasgow, whereby the melting of a plug of hard lubricant caused by the heating of a bearing, allows a spring to drive a hammer and make a number of strokes on a bell, thus calling

Beck'et Hitch. Another name for the FISHERMAN'S KNOT, which see.

Becque-rel' Bat'tery. (*Electricity.*) 1. The sulphate of lead battery, consisting of zinc in sulphate of zinc and lead in sulphate of lead.

2. The oxygen-gas battery. A glass tube containing solution of potash, closed at the bottom by a porous partition, is placed in a flask containing nitric acid. In each liquid is placed a bar of platinum, which being put in metallic connection, a current is produced, the water is decomposed, the hydrogen goes to the nitric acid, which it reduces, and consequently there is no polarization. The oxygen goes to the potash which surrounds the platinum plate. This was the first battery employing two liquids or a porous diaphragm, and consequently the first one to give a constant current.

"*Niaudet*," American translation, 239.

Bed. 1. Fracture beds with limb elevators and suspenders, counter-extension apparatus, splints, cradles, etc., are shown in *Tiemann's "Armamentarium Chirurgicum,"* Part IV., pp. 57, 97, 104.

2. (*Mining.*) A horizontal seam or deposit of mineral.

Bed-mor'tis-ing Ma-chine'. A large mortising machine for working on beds and frames of railway cars, etc.

Fay & Co., * *Thurston's "Vienna Report*," iii. 260.

Bed'stead Joint. The mode of connecting the side-rails to the head and foot portions respectively, so as to be detachable.

The patents on this subject are numerous. Two modes are shown in Figs. 625, 626, p. 262, "*Mech. Dict.*"

Beef Sha'ver. 1. A knife set in a stock in manner of a spoke-shave or slaw-cutter, for slicing dried beef.

2. A swinging knife pivoted on a frame so as to make a draw-cut on the beef which is advanced in the trough beneath. Fig. 256.

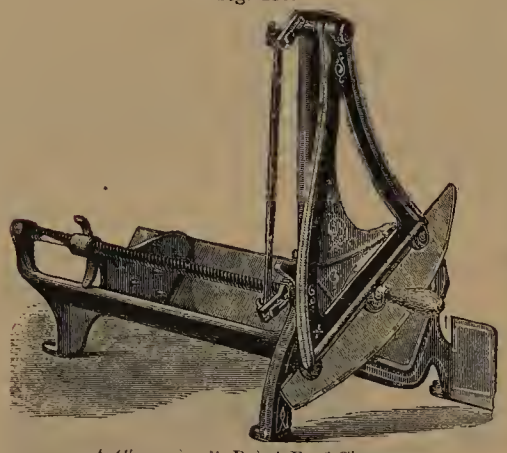
"*Iron Age*," *xxi., March 28, p. 19.

Beer. See the following:—

Barreling Apparatus, Austria.
*"*Engineer*," l. 458 (Figs. 45, 46).

Condenser . . . . . "*Scientific American Sup.*," 87.
Coolers, Austria . . . *"*Engineer*," 1. 266, 303.
Coolers . . . . . "*Scientific American Sup.*," 4076. (Figs. 6, 7, 8).
Preserver, *Weinmar* . . *"*Scientific American Sup.*," 57.
Refrigerator, *Hoerr* . . *"*Scientific American*," xl. 22.
Beer Resuscitating Apparatus, Austria. *"*Engineer*," 1. 462 (Figs. 49, 50).

Fig. 256.



"*Champion*" *Dried Beef Shaver.*

Beer, Con-densed'. Beer reduced in a copper vacuum pan to $\frac{1}{18}$th its bulk in solids, and an equal quantity of alcohol: 36 gallons of beer making 2 gallons of solids and 2 of alcohol, to be remixed.

Dr. Bartlett in "*Scientific American Supplement*," 191.

Beer Cool'er. The devices are numerous. Two are shown at Figs. 631, 632, pps. 264, 265, "*Mech. Dict.*" They take the form shown in other industries, and various shapes; the same in principle may be found under "*Condenser*," "*Evaporator*," *Ibid.*

The "*Refrigerant Dubuc*," made at Carignan (*Ardennes*) is a favorite in France. It is on the method of trickling over pipes, — the Derosne principle. Fig. 1421, p. 609, *Ibid.*

The *Roos* refrigerator follows the same idea.

The *Trageser* cooler also.

The Austrian beer cooler, by *Raimond Metsche*, at Olmutz, has a system of circulating pipes in the wort or beer back.

Weinhagen's beer cooler is for quickly cooling a small quantity of beer for testing the strength of the wort.

Woerle's cooler consists of tin vessels freighted with ice swimming in the vat.

An elaborate apparatus, *Patent-gegenstrom Bierkühlapparat*, on the system of Brüder, Noback, and Fritze, of Prague, was shown at Paris. It consists of convolutions of double pipes, one carrying the beer and the other the cold water, circulating continuously in different directions.

Beer Pre-serv'er. An arrangement by which the space in the barrel above the beer is filled with carbonic acid gas from a reservoir alongside. Wiesebrock's.

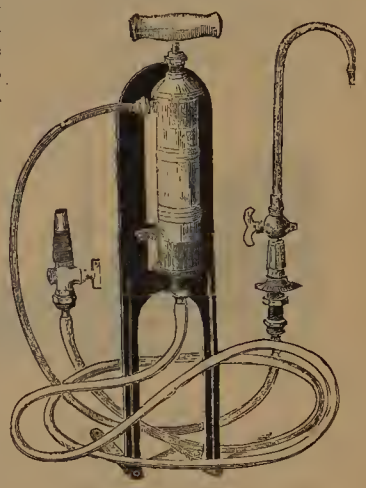
Fig. 257.

Beer Preserver.

The apparatus of Otto Zwietusch, of Milwaukee, is a regular carbonic acid gas generator, with marble-dust and acid chambers, gas washer, holder, etc., with connecting pipes and valves, to serve a row of barrels or kegs under draft. Patents, May 19, and July 2, 1874.

Beer Pump. A hand-pump, forming a connection between a counter in a saloon and the barrel in the cellar. The pump has two tubes, with a barrel cock at one end and a dispensing goose-neck at the other.

Fig. 258.



Beer Pump.

Bees. (*Nautical.*) Of a bowsprit: *bee-blocks.* Pieces of wood bolted to the outer end of a bowsprit to reeve the fore-topmast stays through.

Bees'wax. A fraudulent imitation of beeswax is made of a mixture of paraffine and common resin. It resembles the genuine article very closely in color, fracture, and adhesiveness.

The cakes are generally covered with a thin coat of genuine beeswax.

Beet Gra'ter. A machine for grating beet-root for obtaining the juice by expression or diffusion in the manufacture of sugar.

"In the California machine, of the Union Iron Works, San Francisco, the beets are fed continuously into a hopper, which is at the top of the machine. Directly under the hopper are two ways, or sluices, in which the feeding plungers slide. The plungers are actuated by the revolution of a cranked shaft, through the medium of slotted levers and connecting links. The turning and sliding of the cranks in the slotted levers gives a quick return motion to the plungers, and causes their forward motion to be almost constant. The forward motion of the plungers presses the beets, which have fallen into the sluices, while they are drawn back, against a quick revolving drum, which makes about 600 or 800 revolutions in a minute. The drum consists of three grooved flanges, about 22″ diameter, mounted on a shaft, and having 8″ space between them. The grooves are in the inside faces of the flanges, and near their circumferences. They are filled with strips of steel saws, with a strip of wood setting back from the points of the teeth between each two of the blades. About 400 saws are necessary to fill a double drum of these dimensions. The drum, revolving at a high speed, grates the beets which are pressed against it, and discharges the pulp into a chute which leads it into movable hoppers, by which it is transported to the centrifugal machines."

See Beet-rasping Machine.

Beet-juice Def'e-ca'tion Pan. The purifying process formerly adopted with beets was as follows: The juice in the defecating pan was rapidly heated to 185° F. At this moment milk of lime was poured into the juice and well stirred in. When a thin layer of scum had formed on the top of the juice, the supply of steam was gradually shut off, so that at the moment of ebullition the supply of steam was one fourth the original quantity. The steam was suddenly cut off when ebullition was fully developed, indicated by an eruption of clear juice on the surface.

The juice was then filtered through animal char-

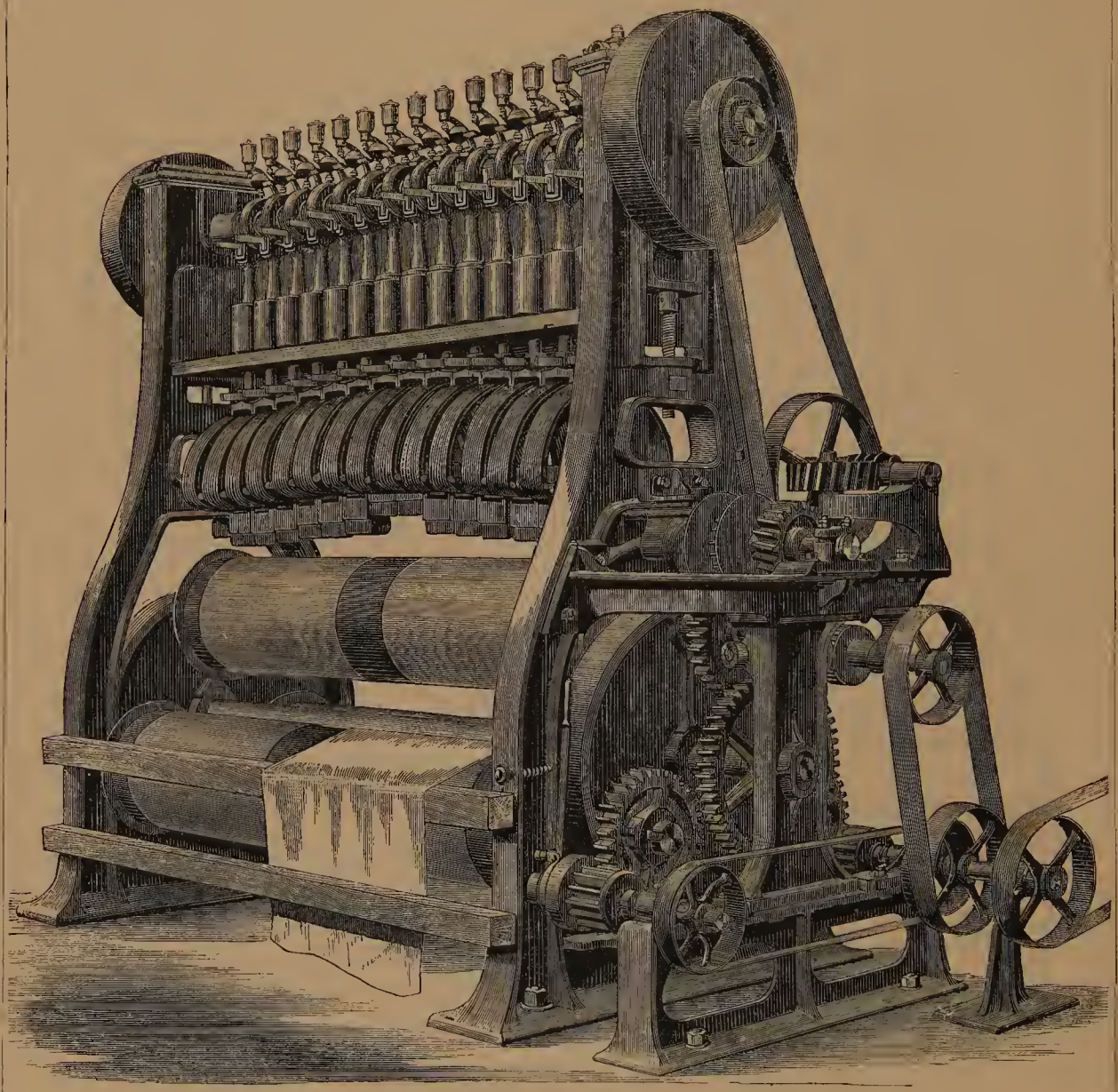


PLATE V. PATTERSON'S BEETLING MACHINE. (MATHER & PLATT, MANCHESTER, ENGLAND.) See p. 87.

coal. CARBONATATION (which see) has beeu largely substituted for the above proccss.

Bee'tle De-stroy'er. An implement or machine for killing the potato bug. Numerous kinds are noted under INSECT DESTROYER, which see.

Bee'tling Ma-chine'. A machine for fiuishing linen or cotton goods by a hammering process. The beetling machine rcferred to on p. 265 of *"Mech. Dict.,"* had a series of vertical stamps lifted by pins or cams in manner of an ore-stamping mill, but the Patterson beetling machine made by Mather & Platt, of Manchester, England, and shown in Plate V., has a series of spring-hammers worked at high speed. These hammers are worked by eccentrics on a shaft which extends along the top of thc machine, there being interposed between the eccentric rods and the hammers a spriug connection which relieves the working parts from the recoil of the blows, and matcrially reduces wear and tear. The spriug connection is made by suspending each hammer from a leathern belt attached to a semicircular steel spring.

In the old-fashioned beetling machines the hammers or *fallers* were lifted by cams, and allowed to drop by gravity, while the utmost speed at which they could be run was about sixty blows per minute. In the Patterson machine the hammers each give 420 blows per minute, while the striking effect of each blow is the same as in the old machine. The hardncss of the blow can, however, be varied by altering the speed.

The cloth being operated upon is carried by one of three rollers which revolve in bearings carried by disks, as shown, these disks being themselves capable of revolving. The three cloth rollers can thus be brought successively under the action of the hammers, and the operation of the machine is thereby rendered continuous, the filling and stripping of the rolls not interfering with the beetling.

"*Engineering*," * xxvi. 91.

Beet Press. One for pressing the juice from the grated pulp of the sugar beet.

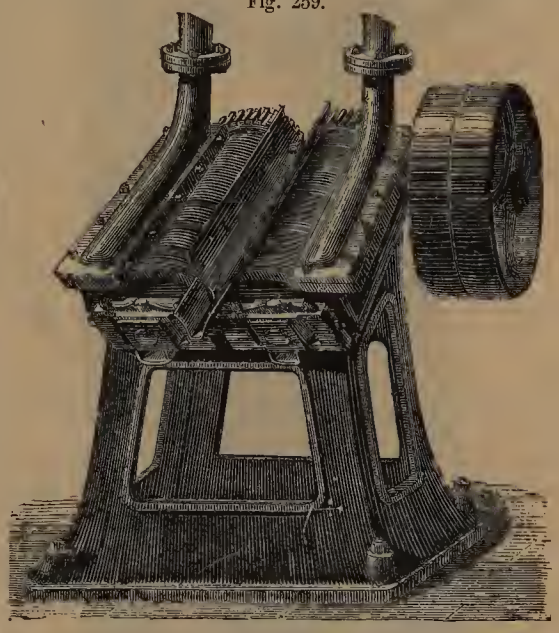
The beet industry has attained its great proportions since the hydraulic press has been iu common nse, and this description of press in various modified forms is well adapted to this industry.

Lalouette introduced the arrangement which dispensed with the use of sacks which were and are used in the stearine and flaxseed-oil works. He made a chest with strong iron bars lined within with a perforated copper sheet. Sheets or cloths divided the marc into layers. A second prcssing was necessary, the first was frequently done in a filter-press (which see), and the pulp fell from that into the chest of the Lalouette press. Sixty per cent. of the juice was obtained.

The direction now seems to bc in the line of continuous presses, which so much reduce labor in handling. They usually depend upon rollers.

The cylinders of continuous presses are, (1) constructed with apertures perforating their rolling surface, so that the juice is caused to pour into the interior, from which it is allowed to escape, as in the presses of Pecquer, Champonnois, and Lebée; or (2) the pulp is carried, by means of endless belts of linen or jute, betweeu a series of solid

Fig. 259.

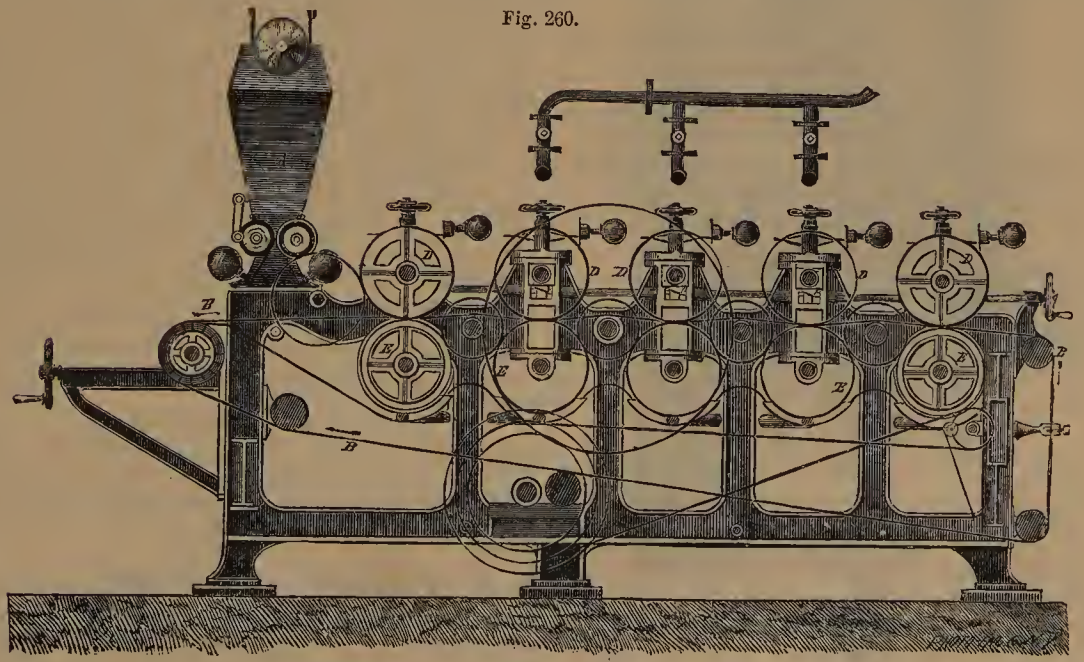


Champonnois' Continuous Press.

rollers, effecting a gradually increasing pressure, as in the presses of Poizot and Manuel & Socin.

1. Pecquer commenced with cylinders perforated

Fig. 260.



Manuel & Socin's Continuous Beet-press. (French.)

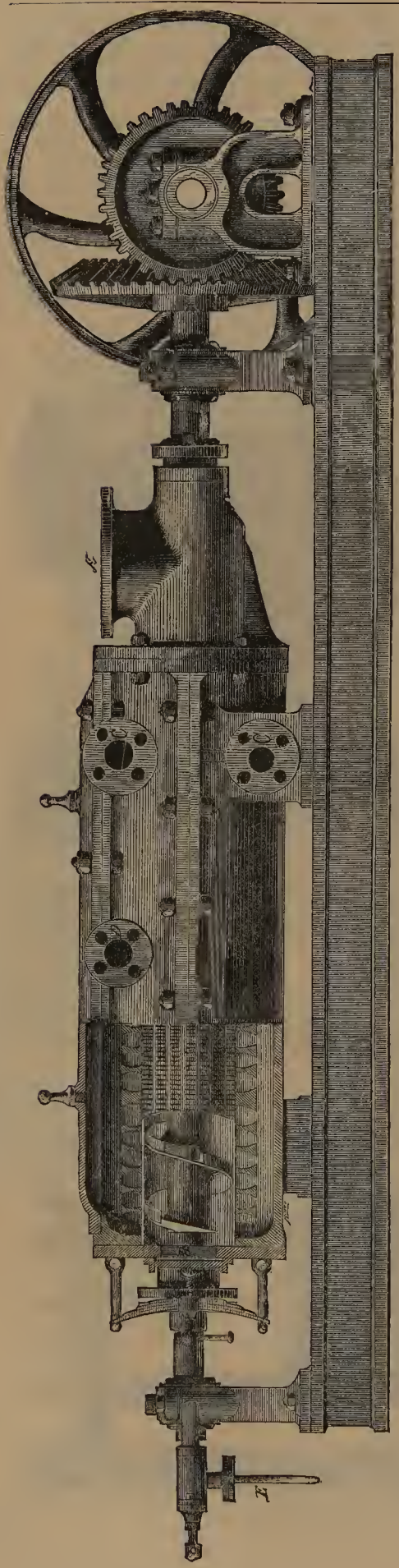


Fig. 261. *V. Pieron's Continuous-screw Beet-press.* (*French.*)

A Entry of pomace. *B.* Exit of pulp. *C C.* Exits of juice. *D.* Entry of water for washing. *E.* Supply of water for injection through center of screw.

with round holes, but Champonnois improved upon this by making longitudinal slits in the cylinder and adding a spiral wire covering, which gives an infinitude of extremely narrow exits for the juice. Fig. 259.

The Lebée press has cylinders whose peripheries consist of movable frames made of narrow bars and intervals respectively 0.05″ and 0.004″ wide. These are soldered in sets to be replaced readily. The pulp requires several pressings. After passing between the first set of filtering cylinders, the pulp passes under a solid cylinder, rolling upon one of the filtering cylinders, after which it is treated with a spray of water, and again passed under solid cylinders, rolling upon another filtering cylinder.

In the Collette press the filtering surfaces consist of sheets of finely perforated copper.

In the Dujardin press the cylinders are covered with heavy brass sheeting about .08″ in thickness. The openings made in this metallic sheet are cylindrical for a short distance, after which they expand conically toward the under side, and by this means the difficulty of choking the holes is largely avoided.

The difficulty encountered in these presses by the escape of pulp with the liquid is somewhat obviated by the addition of milk of lime to the juice, which seems to solidify the pulp.

2. The continuous presses which have an endless cloth filtering surface, depend upon the principle of subjecting the pomace to a gradually increasing pressure by passing between different series of rollers, the pomace being carried between endless belts of the material mentioned above. The first of these presses is stated by Basset to have been devised in 1812, but Poizot seems to have been the first to make an effective one, and to apply it in industrial work.

That described by Basset consisted simply of an endless sheet carried between two rollers held in contact with each other by means of levers to the farther end of which weights are attached. The material was distributed upon this belt and by it carried between the rollers.

Poizot's press, according to his first design, had two belts between which the pulp was carried around a large cylinder, against which smaller rollers were forced with a gradually increasing pressure in the course of the series, followed by a pressure between two large rollers. Poizot now uses a single web of cloth, the pulp passing over the small rollers and in contact with the large cylinder. The pulp falls from the web into a tank, is subjected to a spray of water and passes to a second press.

The Manuel & Socin press (Fig. 260) depends upon the same principle, but the system of rollers is arranged horizontally, and consists of five pairs of cylinders of the same size. The distance between the cylinders of each pair varies respectively, according to its distance from the point of supply. The pressure exerted by each pair of rollers is governed by a strong steel spring, the power of which may be increased or diminished at will by means of a screw regulator.

The pomace from *A* falls between the feed-rollers upon the endless belt *B*, and is carried between the solid rollers *D D D D D* and *E E E E E*. The pressure exerted by the rollers is adjusted by means of screws and springs attached to the journals.

The Leroy press, constructed by Messrs. Mariolle Brothers, of Saint Quentin, is provided with rollers and an endless sheet upon which pulp is distributed by means of a special apparatus called the *préparateur*, founded upon the same principle as the press properly so called; that is to say, in the *préparateur* the material coming directly from the trough

of the rasp and equally distributed upon an endless sheet is submitted to an energetic preparatory pressing by means of a series of rollers, gradually approaching each other more and more, in such a manner as to distribute upon the press only pulp partially exhausted of its juice.

The endless sheet is here a thin sheet of steel piereed with a large number of small holes, forming the filtering surface for the juice. In the press the endless sheet is of the same nature, but it is doubled, as it were, by a woolen sheet, upon which the pulp to be pressed is distributed. Good filtration of the juice is thus assured, and at the same time almost all the fatigue is referred to the metallic sheet. — *La Sucrerie Indigène*, xii. 367.

The Pièron press (Fig. 261) is more simple in construction. It cousists of a screw arranged horizontally within a perforated cylinder of copper, and the whole hermetically iuclosed in an envelope of cast iron provided with internal channels for flow of the juice. The blades of the screw are of copper, and the axis of brouze. The blades are in sectious, and may readily be removed and cleaned. The pulp to be pressed is forced into the cylinder by means of a strong pump, and is carried by the revolving screw toward the other eud. When it first enters the press, the pulp is submitted to very slight pressure, but the pressure increases as the pulp approaches the other end, where it is forced out through a valve so arranged that the discharge of pulp may be regulated at will. A portion of the axis of the screw is hollow, and the portion beyond the discharge orifice connects with the water supply, so that a small quantity of water may be coutinuously added to the pulp at the latter part of the pressing to effect a saving iu the sugar that would otherwise be left in the pulp.

To secure effective work with this as with other continuous presses, the method of double pressing must be employed, and for ordinary working six presses are used for the first pressing, and two for the second pressing. For the first pressing the motive force required by each press is one and a half horse-power, and for the second two horse-power. The advantages claimed for the press are its solidity, slight liability to accident and repairs, and small amount of labor required in its management. The work of grinding and pressing being altogether automatic, one mau can attend to both operations. There is no opportunity for the juice to come in contact with the air between the press and the liming-vat, and there is consequently little or no change. The pulp of the first pressing contains 80 to 83 per cent. moisture, and 7 to 9 per cent. of sugar; and that of the second pressing contains 4 to 5 per cent. of sugar. The final pulp represents 26 per cent. of the beets worked.

See report by Dr. W. McMurtrie, "*On the Sugar Beet and the Manufacture of Sugar therefrom.*" Special Report, No. 28, Department of Agriculture, Washington, 1880.

The following continuous presses are referred to in Dr. McMurtrie's Report on the pages indicated.

Freneh.	*Poizot*		Plate XVI.
	Lebède		Plate XVII.
	Manuel & Socin	Page 142.	Plate XVIII.
	Champonnois	Page 140.	Plate XIX.
	Dujardin	Page 141.	Plate XX.
	Piéron	Page 142.	Plate XXI.

See also the following journals and treatises: —

Maumené . . . . "*Traité de la Fabrication du Sucre.*"
La Betterave à Sucre.
La Sucrerie Indigène.
Basset's "*Guide pratique du fabricant de Sucre.*"
"*Journal des Fabricants de Sucre.*"
Stammer's "*Traité theorique et pratique de la Fabrication de Sucre.*"
Walkoff's . "*Traité de Fabrication et Raffinage du Sucre de Betteraves.*"
Grant's . . "*Beet Root Sugar and Cultivation of the Beet.*"
Beet Root Cultivation . "*Scientific American Sup.*," 1032.
Beet Sugar Industry.
Drouyn de Lhuys . . "*Scientific American*," xxxvii. 169.

Beet-rasp'ing Ma-chine'. The machines for rasping beets are of several forms, three of which, of different constructions, are presented.

It is necessary that the cellular structure of the beet shall be entirely degraded in order that there shall be as little loss as possible in the subsequent operation of pressing, which requires to be very carefully performed, and is, in fact, repeated to express the last attainable quantity of saccharine juice from the pulp. See BEET PRESS.

In the greater number of *sucreries* on the Continent of Europe, the rasping machine forms the first of the series of apparatus in the establishment; but of late another system has come into extensive use, and is increasing in popularity. It is to have the *râperies* in the villages or communes, or on farms of extensive area, and to convey the juice by underground pipe-lines to a central *sucrerie* where the subsequent operations are conducted. This enables a single sugar factory to work up the beets of a much larger area than would be possible were the roots to be carted to the central factory.

The system is the invention of Linard, and some data in reference to it are given under PIPE-LINE, which see.

Its advantages are in —

Placing the heavier portion of the work, and that in which the larger number of workmen are employed, in the villages in which they reside.

Increasing the area of the profitable cultivation of beet in the neighborhood of a *sucrerie*.

The decreased weight to be transported.

The transference of the transport from the roads, which are injured by the heavy carts.

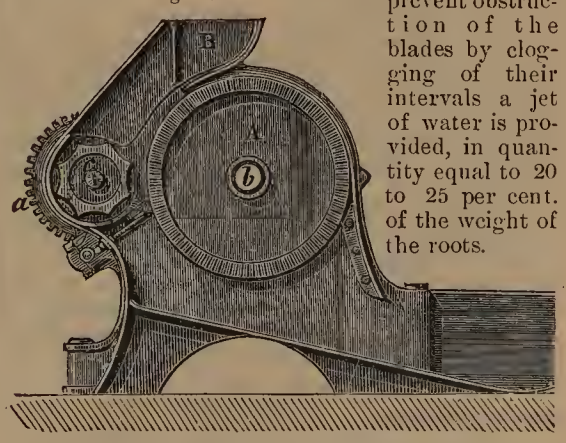
Leaving the residual pulp in the communities where it is needed for cattle and sheep feed.

The opportunity of purchasing the juice by the saccharometer tests instead of by the weight of the roots.

The Lampadius and Kluseman rasps have cylindrical drums furnished with knives, acting upon the roots placed in a hopper, which partially incloses the circumference of the rasping cylinder. The *râpe* of Lampadius is shown at Plate XI. of Dr. McMurtrie's Report on the Culture, etc., of the Sugar Beet, Special Report, No. 28, of the Department of Agriculture, 1880.

The calculation for effectiveness is that a machine which has 70 square decimeters of rasping surface, and 650 turns per minute, which answers to a developed surface of 27,300 meters, will produce 1,000 kilograms of pulp per hour. One horse-power is estimated for each 450 kilograms per hour.

Fig. 262.



Kluseman's Beet-rasping Machine.

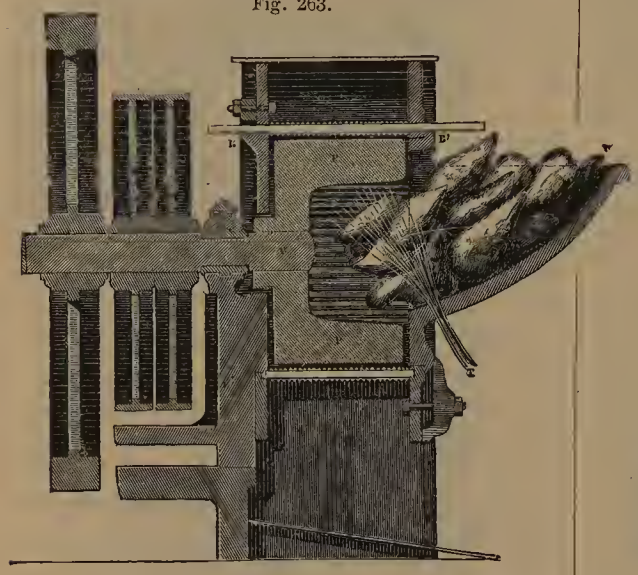
In order to prevent obstruction of the blades by clogging of their intervals a jet of water is provided, in quantity equal to 20 to 25 per cent. of the weight of the roots.

Kluseman's rasping machine, Fig. 262, has a drum *A*, whose perimeter is furnished with radial blades. The roots are put into the hopper *B*, and passing downward, are caught in the flutes of the roller *c*, which makes one turn — towards the rasp — for every 25 revolutions of the rasp. Its duty is to hold the roots against the rasp, and these escape into the box beneath when they are grated sufficiently fine to pass the throat-piece which is

adjustable from beneath. *a* is the cog-wheel which turns the roller *c*; the gearing of the rasp cylinder on the axis *b* is hidden by the machine.

The Champonnois rasp, Fig. 263, has an axis *V*,

Fig. 263.



Champonnois' Beet-rasping Machine.

with heavy cast-iron arms, *P*, which revolve at a rapid rate, and by centrifugal force and actual grinding action force the roots delivered in the hopper *V* against a series of rasps which are arranged circumferentially as at *B B'*, tearing them into fragments, and pushing them through the interstices between the rasps, whence they fall into the box below.

The series of marks, looking like bars, appearing beyond the roots, are the rasps which are set thus close together. At *T* is shown the pipe for the injection of water into the interior of the rasp.

The rasp of Champonnois is powerful, and produces from 6,000 to 7,000 kilograms of pulp per hour, if it be actively fed, and is one of the most efficient root graters.

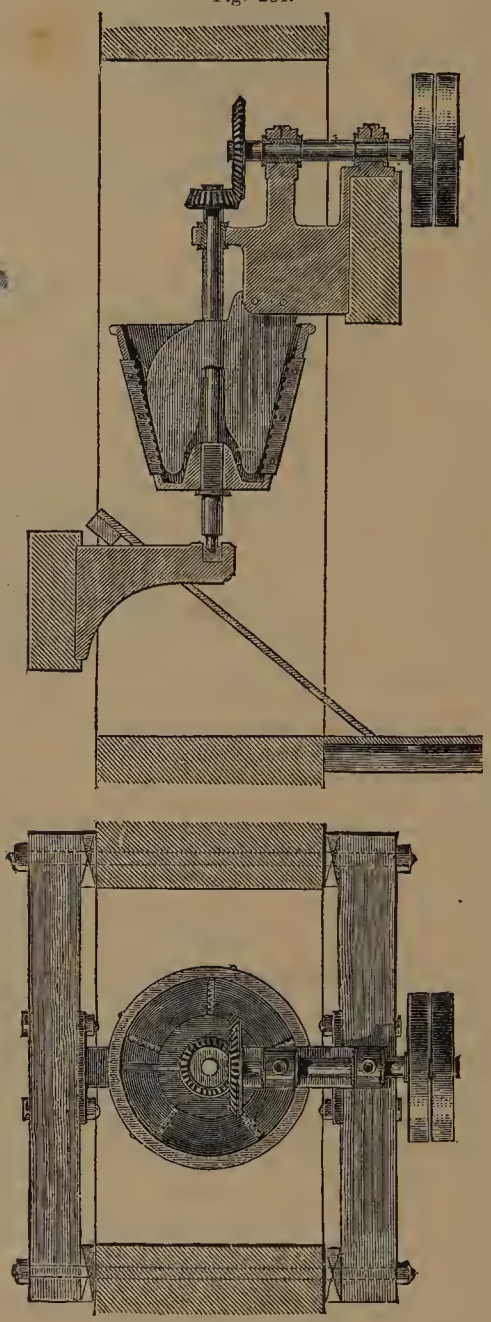
Another form of *coupe-racine* is that shown in Fig. 264, which consists of a cast-iron vase of a frusto-conical shape mounted on a vertical shaft which receives from 200 to 400 turns per minute. The vase has 6 straight openings like the throats of a plane, and each of these has a toothed blade which grates the roots, and the fragments pass out at the openings.

A fixed metallic plate descends into the interior of the vase, acting as an abutment for the roots, to prevent their revolving with the vase, and is distant from the surface of the blades 4 or 5 mm. The size of the pieces is from 0.005 to 0.010 m. × 0.003 to 0.004 m. They are expelled by centrifugal action, and the apparatus requires a casing, which is not shown in the cut.

Beet-root Rasp, Fr.
Lampadius, "*Dept. Agric. Sp. Report*," No. 28, Pl. XI.
Champonnois, "*Dept. Agric. Sp. Report*," No. 28, Pl. XII., XIII.

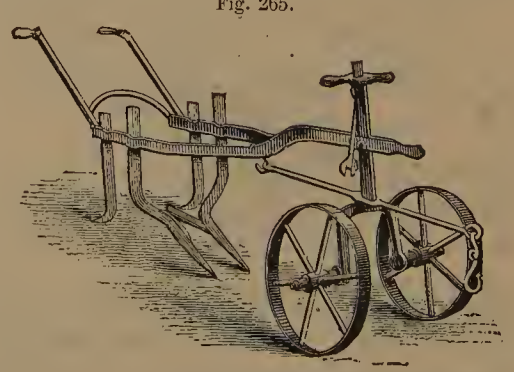
Beet'-root Dig'ger. This generally consists of a sort of fork mounted on a wheeled frame and slanting downward so as to include the root between its prongs, and lift it upward and forward. It injures the beet to bruise it or to break the tap-root, as it bleeds and wastes the sweet juice. Following the fork are prongs which lift the roots clear of the soil in which they are more or less imbedded, as they are simply upset and dragged from the ground.

Fig. 264.



Beet-root Rasping Machine.

Fig. 265.

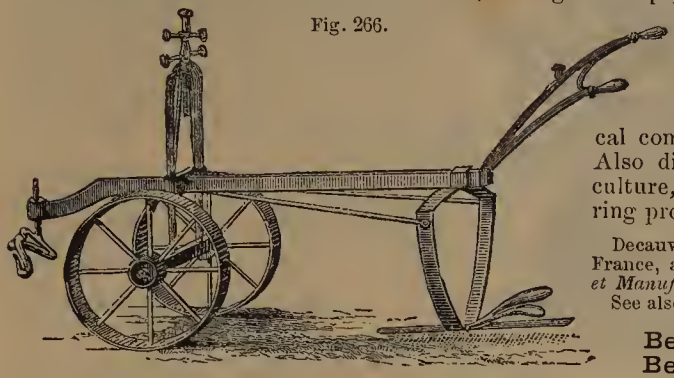


Beet-root Digger.

Figs. 266 and 267 are other forms, made by Delahaie-Tailleur & Bajac, Liancourt, France.

The former has a bow-shaped standard, having

Fig. 266.

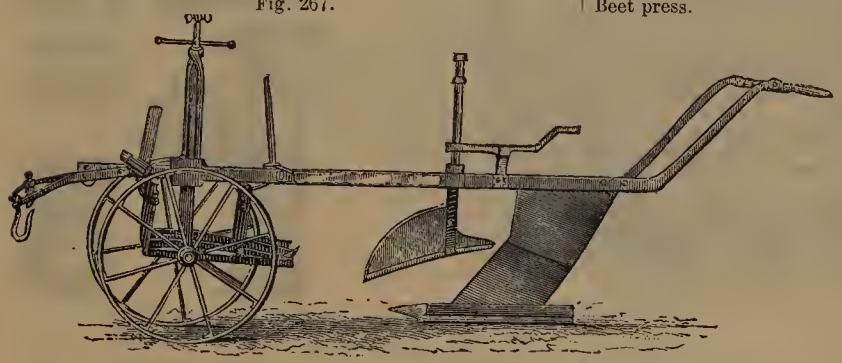


Beet-root Puller.

a lifting share in front and several prongs behind, to raise the beets and leave them on the surface of the ground.

The latter example has a precedent share (*coupe collet*) for cutting off the leaves of the beet simultaneously with the pulling of the root. Several forms of interchangeable shares are furnished with the implement: shares without branches, or with two or three branches, according to the kind of beet and the nature of the soil. The work performed is 1 hectare (2½ acres) per diem.

Fig. 267.



Beet-root Digger.

French beet-root pullers are shown in *Knight's "Report on Agricultural Implements," Paris Exposition Reports,* * vol. v., pp. 51, 52.

See also "*Scientific American*," * xxxix. 165.

Beet'-root Sli'cer.

The centrifugal root cutter of the "Union Iron Works," San Francisco, "is composed of a stationary drum, in the form of a truncated cone, provided with six grooves, into which are fastened as many grooved-toothed knives. To this drum is attached the feed hopper. A horizontal shaft which is keyed to the head pulley, carries at one of its ends a cast iron disk, armed with two flyers, turning in the stationary drum, and leaving a working space between the edge of each and the inner wall of the drum. The beets come from the washing machine through a channel into the hopper, and thence to the drum. Here the flyers of the disk drive them violently against the blades of the stationary drum, where they are cut into slices of a uniform thickness of one sixteenth of an inch, and a width of about three eighths of an inch. The stationary drum is surrounded by a thin casing of sheet iron, the object of which is to direct the slices thrown out of the machine, downward. This casing is movable, so as to give access to the knives, and allow them to be taken out.

This machine can cut three tons of beet-root in half an hour, with the shaft moving at the rate of 350 revolutions per minute. A single horse power is all that is necessary to actuate it. The blades are fastened into the grooves by screw bolts, and can be adjusted and set at any desired distance apart within given limits."

Beet'-root Su'gar Ap'pa-ra'tus. For a recent timely and excellent treatise on the inception, progress, and success of the beet-root sugar industry in Europe, see Dr. McMurtrie's Report, "*U. S. Department of Agriculture, Special Report, No. 28,*" 1880.

It includes also tables and maps, indicating the regions in the United States included in the belt, where the meteorological conditions favorable to beet culture prevail. Also dissertation on varieties of beet, analyses, culture, manuring, harvesting, and manufacturing processes and apparatus.

Decauville's beet-root machinery and still, at Petit Bourg, France, are described in *Laboulaye's "Dictionnaire des Arts et Manufactures,"* vol. iv., ed. 1877, Article "*Distillation.*" See also "*Sucre*" in same work, iii.

Beet Pul'ler. See BEET-ROOT DIGGER.

Beet'-root Su'gar Ma-chin'e-ry. The series of machines made by the Union Iron Works of San Francisco is as follows: —

Beet-washing machine.	Grating or pulping machine.
Bone-black washer.	Hydraulic press.
Carbonic acid pump.	Lump breaking machine.
Centrifugal machine.	Monte-jus.
Charcoal filter.	Sugar-mixing machine.
Defecating pan.	Vacuum pan.
Evaporator.	Vapor pump.
Filter press.	Vivifying kiln.

Notices or references will be found under the following heads: —

Animal charcoal revivifier.	Beet-seed drill.
Beet grater.	Bone black revivifier.
Beet juice defecation pan.	Cane cutter.
Beet press.	Cane mill.
	Carbonatation.
	Centrifugal filter.
	Charcoal washer.
	Concentrating apparatus.
	Condenser.
	Cube-sugar machine.
	Cultivator, Beet.
	Defecator.
	Diffusion process
	Evaporator.
	Filter.
	Filter press.
	Hand drill
	Hydraulic press.
	Malaxator.
	Ridging plow.
	Root cutter, Beet.
	Root digger, Beet.
Beet rasping machine.	Seed drill.
Beet-root digger.	Silo for beets.
Beet-root slicer.	Sugar diffusion process.
Beet-root sugar apparatus.	Vacuum pan.

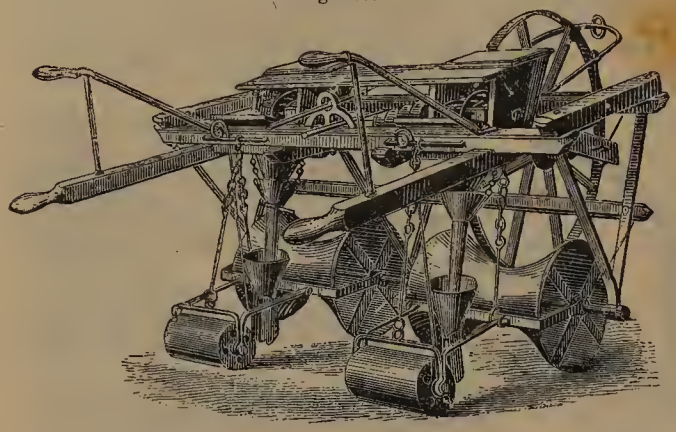
Beet-seed' Drill. A machine for drilling beets, usually upon a ridge listed up.

Fig. 268 is a drill for beet-seed or turnips, made by Corbett & Peele, of Shrewsbury, England. It is specially adapted for sowing on the summits of ridges. The machine drills two parallel rows. On each side of the machine is a concave ridging-roller, a hollow share which receives seed from the box above, and an iron roller for covering the seed. The seed-wheels are of the usual English form, having little hemispherical cups which dip up seed and drop it into hoppers, from which conductors lead to the hollow shares which open the furrows.

The beet-seed drill of Smyth & Sons, of Peasenhall (Suffolk), England, has a range of 5 hoes with a distance apart of 0.45 meter, but the machines vary in the number and interval distance of the hoes and in price.

The seeding is performed by its own set of conductors and hoes, in such manner that the fertilizer is covered with earth in advance of the deposit of the seed, which is not placed in contact with the fertilizer, so that the special nourishment to the roots of the young plant is not furnished until they

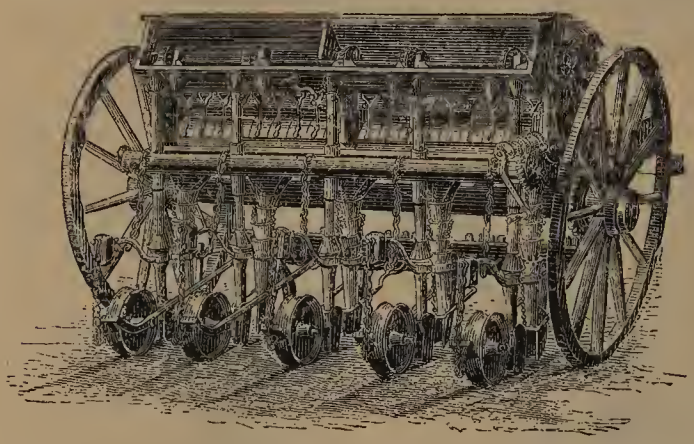
Fig. 268.



Beet-seed or Turnip Drill.

have attained a certain development. The concave-faced rollers, which are independent of the hoes, follow in the rear and make a little ridge over the seed and fertilizer, which compacts the soil and makes the row of plants more conspicuous in the earlier stages of their growth.

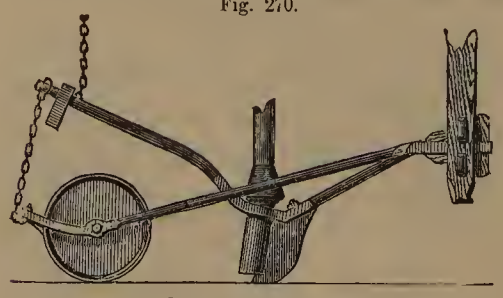
Fig 269.



Beet-seed Drill.

The device shown in Fig. 270 is for attachment to the ordinary drills of this firm to adapt them to drilling beet seed. The roller has flat, concave, or convex face, as may be ordered.

Fig. 270.



Beet-seed Planter.

English and French beet-drills are shown in Dr. McMurtrie's Report No. 28, Special, Dep. of Agriculture; and in Dr. Knight's report, "*Paris Exposition Reports*," * v., 115-117.

Bell. (*Music.*) 1. An instrument in an orchestra, used for dramatic effects. According to *tone* they are known as *high* bells or *low* bells. Berlioz quotes the use of the former in the graceful chorus in the second act of "*Guillaume Tell*," of which the burden is "*voici la nuit;*" and of the bell in low F, in the 4th act of Meyerbeer's opera, the "*Huguenots*," to give the signal for the massacre. The bell refrain in "*Les Cloches de Cornouailles*" is familiar to most of us.

Sets of bells are used in military music, a number being fixed one above another on a frame of iron, and ranged diatonically in the order of their sizes. They are made to vibrate by a little hammer. See GLOCKENSPEIL, GONG, PAVILLON CHINOIS, "*Mech. Dict.*"

The bells in Japan are not sounded with clappers, but with suspended levers of wood, used like a battering-ram, striking the bell on the outside.

See Report on Bells by *H. K. Oliver*, in Group xxv., vol. vii., "*Centennial Exhibition Reports*," p. 53."

Casting . . . . * "*Manufacturer and Builder*," viii. 54, 228.

Clapper and Hammer, Br.
Mackenzie * "*Engineer*," xlix. 268.

Mending. *Riggs* . . * "*Scientific American*," xxxiv. 230.

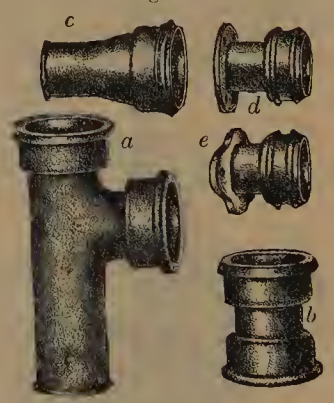
Church . . . . . "*Iron Age*," xxii., Dec. 26, p. 13.

2. The enlarged end of a pipe which receives the smaller end of the next pipe in line. The joint is usually packed with lead or cement. The other usual mode of connection is by flange, which see.

3. The cover in the hopper of a blast furnace top. See BELL AND HOPPER.

Bell and Hopper. (*Metallurgy.*) The charging device on top of a blast furnace. The bell is dropped to allow the contents of the hopper to fall into the shaft.

Fig. 271.

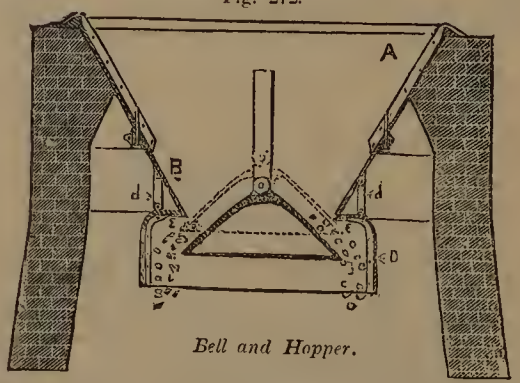


Bells for Mains.

a. Bell T-Pipe.
b. Double Bell
c. Bell and Reducer.
d. Flanged Bell.
e. Saddle-flanged Bell.

A is the hopper in which the stock is placed to feed the furnace. *B* is an extension of the hopper, called the mouth-piece. *C* is the bottom of the hopper called a bell, which is lowered a suitable distance when feeding the stock to the furnace. *D* is an apron or fender, attached to the

Fig. 272.



Bell and Hopper.

mouth-piece *B*, to prevent the stock from striking the walls of the furnace. The apron is secured to the hopper by straps *d d*.

Bell Chuck. Whitworth's lathe chuck, made bell-shaped, with set-screws by which the object is clamped.

Fig. 273.

Bell Chuck.

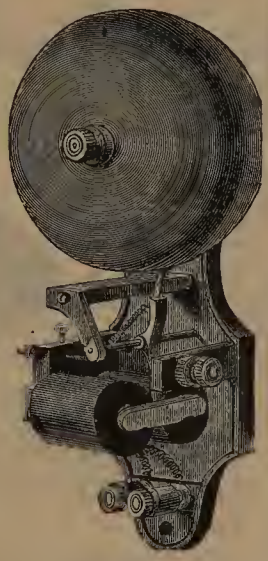
Bell Cord. (*Railway.*) A cord running continuously through the cars, and leading to a signal bell on the engine. It forms a means of communication between the conductor and engineer.

For all the parts and fittings, see "*Car Builders' Dictionary*," pp. 8-10, and illustrations cited, pp. 392 *et seq.*

The inventor of the bell cord on cars was Capt. Ayres, who, in 1842, introduced it on the train of which he was conductor. — *Paterson* (*N. J.*) *Press.*

Bell Mag'net. An audible alarm. A clapper is caused to strike the bell by completing the electric circuit, the connecting wire leading from the apartment whence the call proceeds.

Fig. 274.



Bell Magnet.

Electric bells are now extremely common in departments, offices, manufactories; placing a proprietor or superintendent in connection with any office or department in his building or abroad.

Bell Met'al. An alloy which does not tarnish nor crack, has a good sound, and relatively moderate weight, is prepared as follows: —

Nickel 1 pound, copper 6 pounds, are melted and cooled.

Add zinc 1 pound, aluminum ½ ounce. Melt and cool.

Melt and add ½ ounce quicksilver and 6 pounds melted copper.

Other recipes: —

	Copper.	Tin.	Lead.	Iron.	Zinc.
Useful bell metal	144	53	–	3	–
Useful bell metal	53.5	10	2.13	–	–
House bells	16	4	–	–	–
Soft musical bells	16	3	–	–	–
Common bells	50	15	–	–	–
Bells of Rouen	40	5	2	–	3
Chinese gongs	40	19	–	–	–

An imitation silver, having sonorous quality: —

Take one part of pure pulverized manganese, one part of copper filings, and two parts of animal charcoal. Intimately mix these substances and expose the mixture to a high temperature in a graphitc crucible. After cooling, will be found at the bottom of the crucible, a substance having the appearance and sound of silver. This substance is ductile, malleable, and easily takes the finish of silver.

Bel'lows Steam-en'gine. A form of engine invented by Reilley, in which steam extends longitudinally an expansible bellows-sided chamber, the head of which carries gudgeons which connect by rods to the crank shaft. The moving head, the equivalent of a piston, is in fact placed between two such chambers, which act upon it in succession.

"*Scientific American Supplement*," * 181.

Bell Pump. A bell-shaped pump; used in cleaning gas and service pipes.

Harris, Griffin & Co, in "*American Gas-light Journal*," * July 3, 1876, p. 9.

Bell Punch. A hand-punch, for perforating a ticket or trip slip. It secures the piece punched out, and rings a bell; in some instruments it also registers the fares collected.

Bell Ring'er. Reese's bell-ringer, for ringing the bells of locomotives, is an application of steam to a small piston, which acts upon a sliding bar connected to the bell crank.

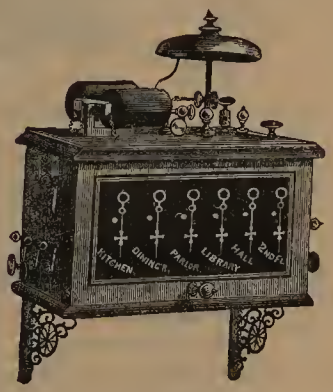
"*Railroad Gazette*," * xxiv. 415.

Bell Rope. See BELL-CORD.

Bell Strap. A signal strap in a street car, reaching along the ceiling to a bell at the forward end. It forms the means of communication between the conductor and the driver; or, in some cars, the passengers and the driver.

Bell Tel'e-graph. An indicator for hotels, steamers, etc. A series of plates inscribed with the numbers of the rooms; the ordinary wants of the guests, etc., are connected by wires with the various apartments, and are displaced so as to attract the attention of the clerk in waiting, by touching appropriate knobs in the various rooms.

Fig. 275.



Bell Telegraph.

In the illustration the apparatus is an alarm telegraph, in which an indicator for each of six apartments may show where the entrance of unauthorized persons has taken place.

Bell Tel'e-phone. The articulating telephone of Alexander G. Bell. See TELEPHONE, TRANSMITTER, etc.

Bel'ly-pipe. A flaring blast-pipe nozzle for blast furnaces. In Vielhaber's patent, 182,621, — the belly-pipe nozzle is hollow, and has inlet and outlet pipes for the circulation of water there through. See, also, WATER BREAST.

Belt. (*Mining.*) 1. A body strap with chain attached by which miners draw corves in the workings.

2. A strap for transmitting motion.

The following dimensions and weights of large belts are given in the journals: —

New Jersey Zinc Co., Newark, N. J., 102′ long, 4′ wide, 2,200 lbs. weight.

J. B. Hoyt, New York, 186½′ long, 5′ wide, 2,212 lbs. weight.

P. Jewell & Sons, Hartford, Conn., 147½′ long, 3′ wide, 1,130 lbs. weight.

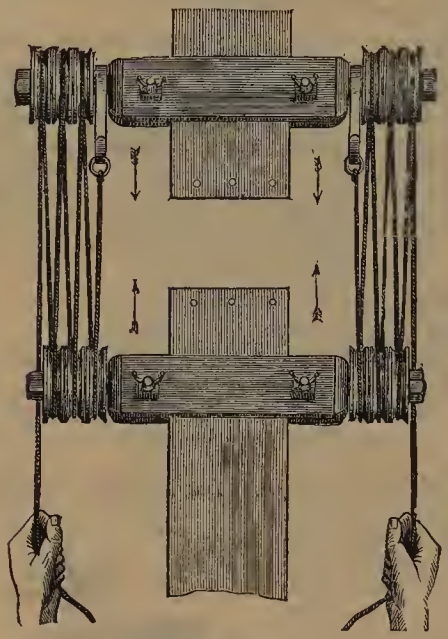
N. Y. Belting and Packing Co. (Makers), 331′ long, 4′ wide, 4,000 lbs. weight. For use in N. Y. Central and Hudson River Railroad Elevator, Sixtieth Street, New York.

Sampson & Co., Manchester, England, 90′ long, 38″ wide. Said by "*British Trade Journal*" to be "the largest ever made in England."

Belt Clamp. A device for approaching the ends of belts in position in order to lace or otherwise attach them.

Fig. 276 has two wooden vises clamped fast to the respective belt-ends, and drawn together by cords and pulleys in order to approach the ends of the belt and hold them while being laced.

Fig 276.



Spiers's Belt Clamp.

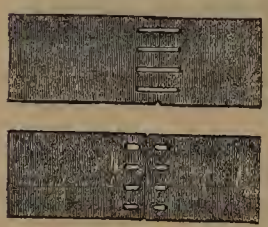
Belt Coup'ling. A device for attaching the ends of a belt. See BELT FASTENER.

Belt Fast'en-er. In addition to the examples of means for attaching the ends of belts, and shown in Fig. 649, "*Mech. Dict.*," several others are here shown. See also BELT SCREW.

Fig. 277.

Lincolne's Belt Fastener.

Fig. 278.



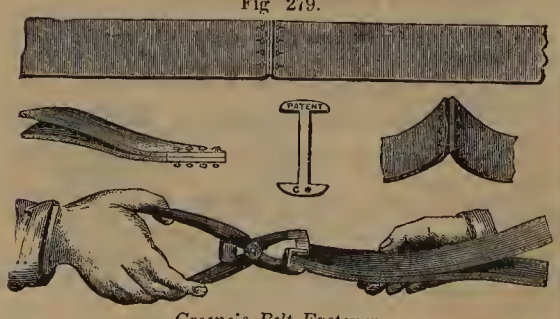
Clinched Staple Belt Fastener.

In Fig. 278 a row of holes being made in each end of the belt, the staples are inserted therein, and the ends turned down and clinched.

Fig. 279 shows Greene's belt-fastener and the tool for inserting the headed pins.

In Fig. 280, in addition to the security of the usual method of attaching the cord to the coupling, — by screwing it in and then riveting, — a gimlet-

Fig 279.



Greene's Belt Fastener.

pointed screw, of the same pitch as the threads in the coupling, penetrates the center of the cord.

Harris's belt fastener is a shield-shaped piece with hooking studs. It is applied as follows: Lay the casting, teeth uppermost, on something solid, place one end of the strap on one of the sets of

Fig. 280.

McBride's Coupling for Round Belts and Cords.

teeth and hammer it on. Repeat the operation, with the other end of the strap on the remaining set of teeth. The curve of the plate gives the hooking position to the teeth.

The following notices may be referred to: —

Several belt couplers, Scholl's "*Mechanic's Guide*," 483-485.

Ends of belt scarfed, glued, pressed, and fastened with shoe pegs, Cooper's "*Belting*," 183.

Dried eel-skin lacings, Cooper's "*Belting*," 183.

Wilson's belt hooks,* Cooper's "*Belting*," 186.

Blake's belt studs,* Patents April, 1860, March, 1861.

"Champion" belt hook,* Cooper's "*Belting*," 186.

Fig. 281.

Harris's Belt-fastener.

McIntosh & Sons, Scotch, machine riveted,* Cooper's "*Belting*," 186.

Lincolne, belt fastener,* "*Engineer*," Jan. 27, 1870.

Belt coupling,* *Howarth*, "*Mech. Mag.*," xciv. 289.

J. B. Hoyt & Co., Cooper's "*Belting*," 188.

Belt fastener, *Badger*, Br., * "*Engineer*," l. 119.

Belt'ing.

Rohrer's "Improved Union Belting" is made by cementing between two or more thicknesses of leather, one or more layers of heavy duck, and then riveting or stitching throughout the entire length.

Walrus hide belting is manufactured from these hides, which are from 0.5″ to 1.25″ in thickness. — "*London Mining Journal*."

Holbrook's folded-twist belting is a round lathe belt. Patented June 18, 1872.

Alexander Bros. patented belting, June 15, 1875, concerns the mode of cutting the hide and making the belt, so as to put the firmest portion of the leather on the edges of the belt, to prevent them from becoming convex on their edges.

Sheep intestines (which average 55′ in length) have been used for belting. — Cooper "*Belting*," xv.

Eel skins, for bands and ropes, "*Journal Franklin Institute*," April, 1844.

Gut bands, Clark's "*Exhibited Machinery of* 1862," London.

Steel belting, "*American Artizan*," Aug. 2, 1865, p. 201.

Round belts of catgut or hemp, Fairbairns' "*Mills and Millwork*," ii. 1.

Round belts in multi-grooved pulleys, *Newton's "*Journal*," 1857, N. S. vi. 163.

Comparison of rubber, gutta-percha, and canvas, with leather. J. B. Hoyt, quoted in Cooper's "*Belting*," 97; Rankine's "*Machinery and Millwork*."

Gut woven into ribbons, *Edwards*, Eng., Cooper's "*Belting*," 128.

Woolen bands, *Heywood*, Eng., Cooper's "*Belting*," 128.

Gutta-percha with wire-gauze core, *Rattier*, Eng., Cooper's "*Belting*," 129.

Raw hide, "*Engineering*," June 19, 1874.

Russian sheet-iron, *Spiers*, Cooper's "*Belting*," 190.

Alexander, Wide leather belting,* Patent June 15, 1875.

Vulcanized rubber belts, Cooper's "*Belting*," 193.

Edge-laid belt,* *Leigh*, Cooper's "*Belting*," 197; see also Haines, Eng., Patent Feb. 14, 1860.

Paper belting, *Crane*, Cooper's "*Belting*," 198.

Water-proofed belting, Cooper's "*Belting*," 200.

Angular belting, *Underwood*, Cooper's "*Belting*," 201

Angular belting, *J. B. Hoyt*, Cooper's "*Belting*," 205.
Compound leathern belts, European, *Auchincloss*, "*Paris Exposition Report*," 1867.
Steel wire flat woven belting, "*Practical Mechanical Journal*," Nov., 1867, 237.
Thin sheet metal coated with rubber, *Sanderson*, Eng., Patent Dec. 8, 1862.
Strips of metal covered with gum, made into a flat band, with a weft of hemp, *Spile*, Eng., Patent Nov. 9, 1859.
Woolen belt covered with resinous cement, "*London Mech. Mag.*," March, 1863.
Alternate links of leather and metal, *Clissold*, "*Franklin Institute Journal*," Aug., 1863, p. 121.
Consult Cooper's "*Treatise on the Use of Belting*," 310 pp. Phila., 1878.
It contains a large collection of authorities, figures, tables, rules, and formulas.

Woven cotton . . . . "*Iron Age*," xxi., Jan. 10, 24.
Calculating power of . "*Scientific American Sup.*," 612.
Jewells' factory . . . * "*Scientific American*," xlii. 95.

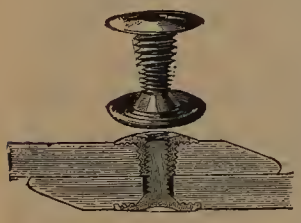
Belt'ing Ce-ment'. For leathern belting. Take common glue and American isinglass, equal parts, place them in a boiler and add water sufficient to just cover the whole. Let it soak ten hours, then bring the whole to a boiling heat, and add pure tannin until the whole becomes ropy or appears like the white of eggs. Apply it warm. Buff the grain off the leather where it is to be cemented; rub the joint surfaces solidly together, let it dry for a few hours, and it is ready for practical use; it is said that, if properly put together, it will not need riveting.

Belt La'cing.

Dried eel skins . . . . . Cooper's "*Belting*," 183.
Directions for lacing paper belting Cooper's "*Belting*," 187.
Annan . . . . . "*Sc. Am.*," Jan., 1866.

Belt Screw. A clamp screw for fastening belts. The fastening consists of two screws, one with a right and one with a left hand thread. The former is of bronze and has a coarse exterior thread cut conically, while the hollow has a fine thread tapped inside. The interior screw is of steel, and has a conical shoulder underneath. The heads of both screws are slightly rounded and formed with circular grooves on the under side, to give them a firm grip on the leather. The conical screw is first run into the leather, and the steel screw is then introduced. The belt is run with the head of the latter on the inner side.

Fig. 282.

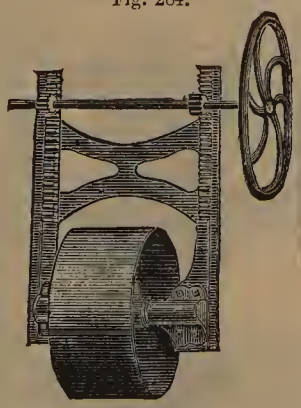


Sonnenthal's Belt Screw.

Fig. 283.

Belt Shipper.

Fig. 284.



Noyes' Belt Tightener.

"*Engineering*," * xxviii. 69.
"*Engineer*," . * xlviii. 84.

Belt Ship'per. 1. A pivoted lever, to shift a belt from a tight to a loose pulley, or *vice versa*. Fig. 653, "*Mech. Dict.*"

2. A hand implement: a conical pin with a flange, on the end of a staff. See Fig. 273.

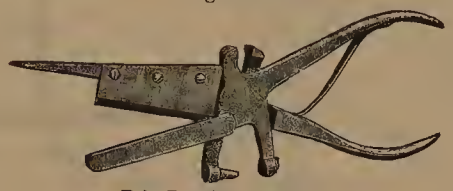
Selig . . . . . "*Engineering*," * xxiv., 135.
Cooper on "*Belting*," 209.

Belt Ten'sion Ap'pa-ra'tus. Apparatus for determining the variation of tension of belts, used by A. Morin, * Cooper's "*Belting*," 244. See also "*Morin's Mechanics*," N. Y., 1860.

Belt Tight'en-er. In Noyes' belt tightener the pulley is journaled in an iron frame capable of being moved in slides by means of rack and pinion, to increase or diminish the frictional adherence of the belt.

Tightener . . . *Walker* . . . * "*Am. Miller*," v. 141.
Tightening pulleys, *Sellers* . . . * "*Engineer*," xlii. 64.
Cresson . . . * "*Engineer*," xlii. 64.
Jones & Laughlin. * "*Engineer*," xlii. 64.

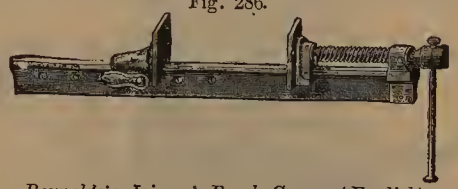
Fig. 285.



Belt Punch and Cutter.

Belt Tool. A combination of punch, cutter, awl, and nippers.

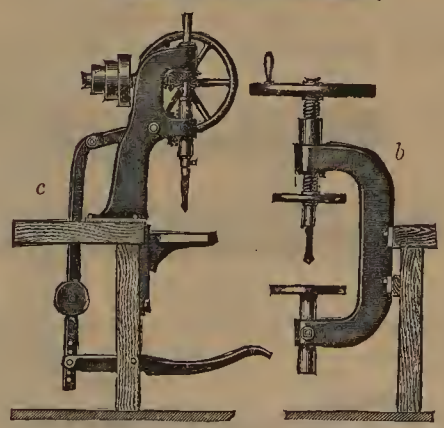
Fig. 286.



Reynolds's Joiners' Bench Cramp (English).

Bench Cramp. A clamping tool used on a bench in securing pieces of work together, or holding a piece while under treatment.

Fig. 287.



Bench Drills. (Atlantic Works.)

Bench Drill. A hand or machine-drill attachable to a bench.

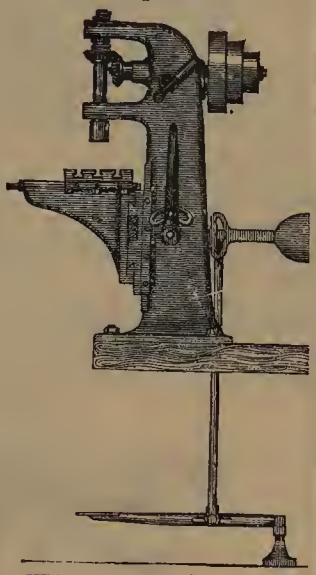
Fig. 287 shows: —

a. A hand-drill on vise-bench, the spindle horizontal

b. Drill arranged with cone for countershaft, and adapted to be driven by power or by hand; the spindle adjusted by the foot.

c. Drill on vise-bench; spindle vertical.

Fig. 288.



Whitworth's Bench Drilling Machine.

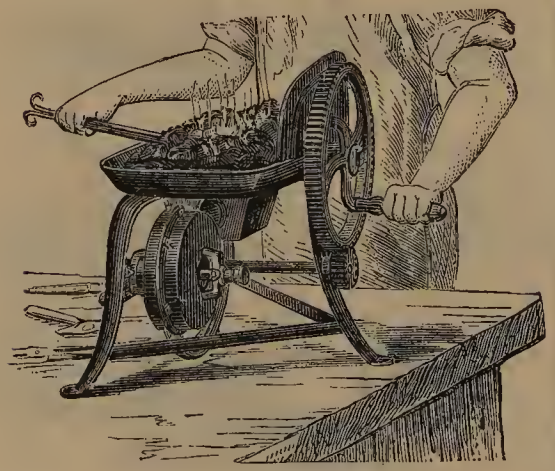
Bench Dril'ling Ma-chine'. In Sir Joseph Whitworth's bench drill, the machine is fixed to a bench, and the work on the rest is raised to the drill by hand-lever or treadle.

Bench Forge. A small hearth and blower, to be used on a workman's bench. Fig. 289. Such a forge will weigh 50 pounds, and heat to redness $\frac{3}{4}''$ iron in two minutes.

Bench Hatch'et. One of the form shown in Fig. 293, is used in bench-work.

Bench Lev'el. A machinist's level, Fig. 290, used in setting up machines in placing their beds strictly horizontal.

Fig. 289.



"Empire" Bench Forge.

Bench Sail'-hook. A hook used by sailors

Fig. 290.

Bench Level.

and sail-makers as a holder for the sail when sew-

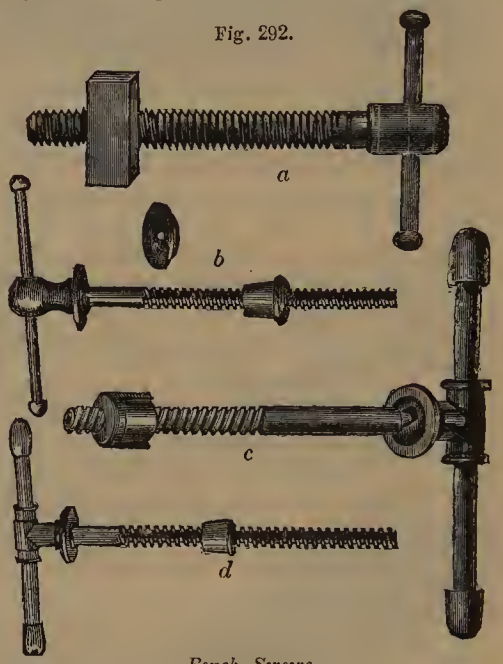
Fig. 291.

Sailmakers' Bench Hook.

ing. The loop being passed over a nail or other object, the sail is caught upon the hook and held against the pulling of the sailmaker as he hauls his canvas taut to make a straight seam.

Bench Screw. The screw for fastening the vise jaw of a carpenter's bench.

Fig. 292.

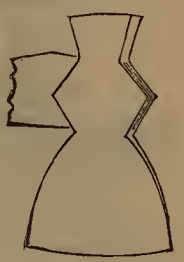


Bench Screws.

a, is the ordinary wooden bench screw.
b, is an iron screw with iron handle.
c, *d*, are iron screws with wooden handles.

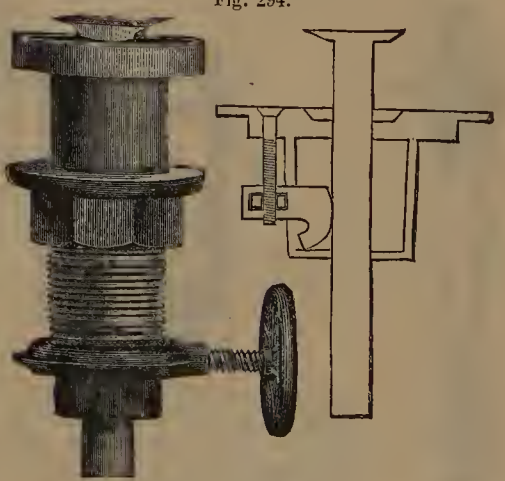
Bench Stop. A device on a carpenter's bench which can be raised to hold a piece which is being worked, against the thrust of a plane. In the ordinary form it is a square prism which is lifted above the general level of the bench, but in the superior forms shown in Fig. 294 the piece is of iron, has a talon and is adjustable. The bench stop on the left in Fig. 294 has a screw socket in which the stop is raised and held by a screw. The other bench stop in the figure is held by a cam-piece which is controlled by a screw.

Fig. 293.



Broad or Bench Hatchet.

Fig. 294.

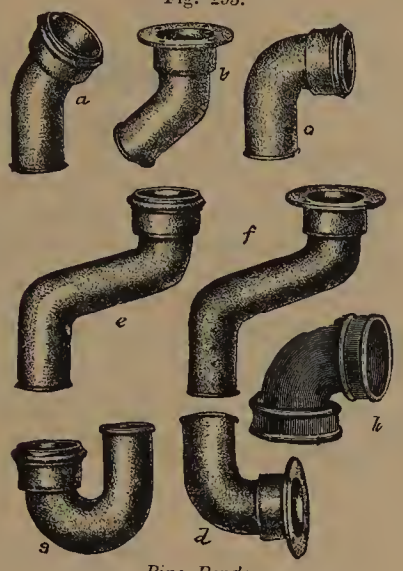


Bench Stops.

Bend. A flexed pipe, changing the direction. If it be angular, it becomes a *branch*.

Bend'ing and Straight'en-ing Ma-chine'. A machine for bending or straightening iron bars or plates.

Fig. 295.



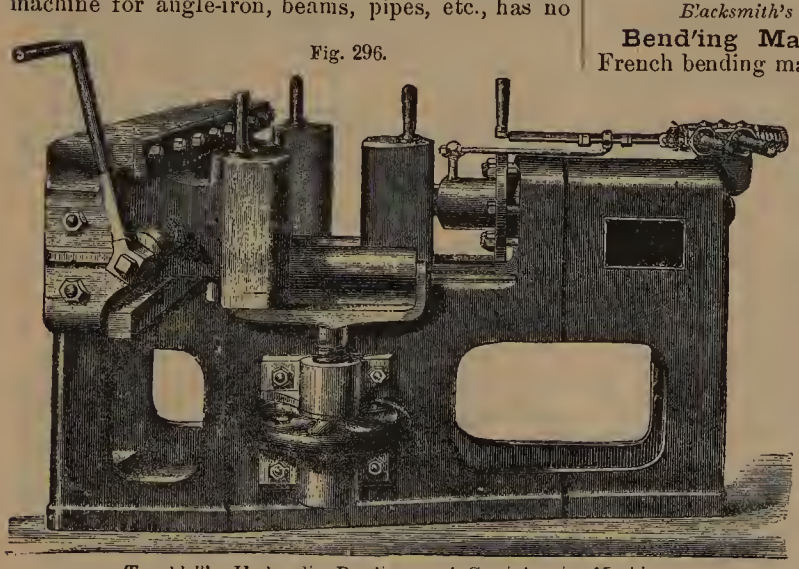
Pipe Bends.

a. Eighth bend.
b. Flanged eighth bend.
c. L or quarter bend.
d. Flanged L bend.
e. Offset bend.
f. Flanged offset bend.
g. Return bend.
h. Double hub bend.

Bement's machine is capable of bending plates of any length up to 10½′. Both lower rolls have a positive motion by gearing and are driven by two belts, by which they can be run in either direction. Each of the rolls is cast upon a large wrought iron shaft forming the journal bearings, the upper one being extended at one end to receive the pressure of a screw, which supports the upper roll when a circle or flue is to be removed at the other end, the jointed bearing being movable for that purpose. The two ends of the upper roll have a vertical adjustment, together, or separately, by hand-wheels at the end of the machine. The usual diameter of the lower rolls is 10″, upper roll 11″.

Tweddell's hydraulic bending and straightening machine for angle-iron, beams, pipes, etc., has no

Fig. 296.



Tweddell's Hydraulic Bending and Straightening Machine.

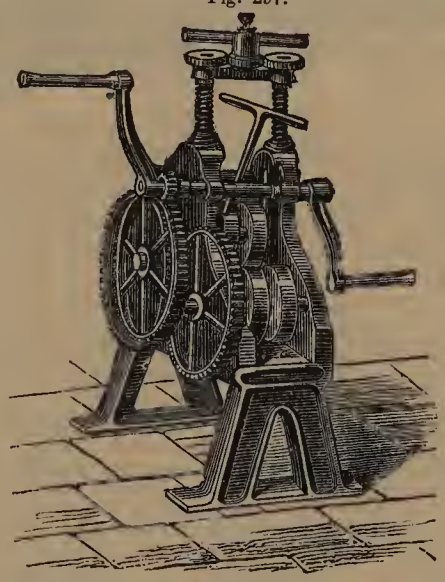
gearing, and the pressure cannot exceed that due to the accumulator. The machines are generally made to work at a pressure of 1,500 lbs. per square inch, this being the pressure at which Tweddell's riveting, punching, and shearing machines work; but they can be made to work at any other pressure if desired. The position of the abutting blocks is altered by means of a right and left-handed screw, thus ensuring exact work and saving much labor.

The stroke of the machine can be varied from *nil* to the maximum travel; this is an advantage over a geared machine, or when a cam is used, since the cam must either complete its revolution, or else a break-down occurs, should too large a piece of work be put in. By means of the tappet-gear exact uniformity of stroke can be obtained for consecutive operations; the valve can be worked by the man's foot if desired, leaving his hand free; and the pressure can be kept on as long as desired.

Several of these machines of different powers are found in the British and French government dock-yards.

Hyd. Toulon Arsenal . . *"*Engineer,"* xliii. 24.
Bennie, Br. . . . . *"*Engineer,"* xliv. 386.
Bar Straightening Machine . *"Iron Age,"* xix., Jan. 18, 3.
Howells . . . . . *"*Scientific Am.,"* xxxiv. 306

Fig. 297.



Blacksmith's Bending Machine. (*French.*)

Bend'ing Ma-chine'. Fig. 297 shows a French bending machine, for cart and wagon tires. It is adjustable in respect of the proximity of the wheels, in order to regulate the radius of the curve of the tire to suit wheels of varying sizes.

Bend'ing Tool. (*Blacksmithing.*) A tool for bending a heated rod. In one form shown in Fig. 298 it is a hand bar with a crotch; in the other the crotch is to be planted in the hardy-hole of the anvil, in the manner of a swage-tool.

Bent Beam.

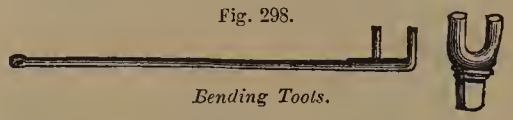
An article on bent and built arched beams, published in the "*Building News*," was reproduced in "*Scientific American Supplement*," * 2035. It has numerous references, ancient and modern.

See also Figs. 312-316, pp. 138, 139, "*Mech. Dict.*," and *Price's* "*British Carpenter.*"

L'Orme's "*Nouvelles Inventions pour bien Bastir*," 1561.
Emy's "*Nouveau Système d'Arcs pour les Grandes Charpentes.*" Paris, 1828.
Tredgold's "*Carpentry.*"
Gwilt's "*Cyclopedia of Architecture.*"

Be-rard′ Steel. (*Metallurgy.*) Steel made by adding hydrogen gas to the air-blast of Bessemer, to remove sulphur, phosphorus, and arsenic.

Fig. 298.



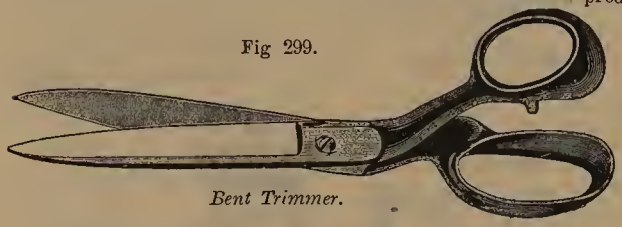
Bending Tools.

Ben-zine′. A hydro-carbon product of petroleum.

Ben-zole′. A hydro-carbon product of coal, made from coal-tar. Distinguishable from *benzine* by placing a piece of pitch in a test-tube. Benzole dissolves it into a tar-like mass. Benzine is scarcely colored by the pitch.

Benzole, its compounds and derivatives,
"*Scientific American*," xliii. 200.

Fig 299.



Bent Trimmer.

Bent Trim′mer. A tailor's shears, bent in the handle so as to make the scissors run more readily upon the board on which the cutting is being done.

Bent Wood Fur′ni-ture. A Vienna industry which has been widely extended of late.

The wood employed is Carpathian mountain beech. The practice in Kohn's factory, in Vienna, is about as follows: —

"The wood to be utilized is cut in the forest, by means of easily transportable steam saw-mills, directly into strips of the dimensions that the separate pieces of the furniture have in the rough. These strips are then conveyed to the factory, where a considerable quantity is simultaneously subjected to the action of steam, until it is both thoroughly saturated therewith, and the vegetable juices largely removed. In this condition the wood is extremely flexible, and when dried is far more durable than when in its natural state, inasmuch as the operation washes out all the soluble constituents and leaves the unalterable cellulose, or woody fibre, behind.

"After steaming, each of the pieces is forced into an iron form, having the shape which the stock is finally destined to possess, and allowed to remain there until quite dry. The several subsequent processes of joining and finishing, involved in the union of the bent sticks into the completed article of furniture, need not be described.

"The advantages possessed by furniture constructed of bent instead of sawed pieces may be briefly summarized as follows: The bent wood furniture possesses superior strength and durability, with the smallest quantity of material, which permits of that admirable combination of lightness with elegance of design which characterizes this class of furniture. The widest scope is allowed for the exercise of artistic talent since the bending process permits of the production of the most varied and intricate patterns." — *Official Report.*

Ber′lin I′ron Work. Very fine cast-iron work such as jewelry, chains, etc., made in Berlin. The art is said to have originated in 1813, when the people of Prussia generally gave their jewelry to the government to assist in resisting Napoleon, and received in exchange similar articles made of cast iron. Some of the separate pieces of which these articles are made up are so small that it is said that there are nearly 10,000 in a pound weight.

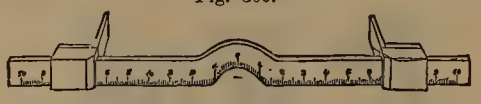
Berth. A bed in a vessel's cabin or state-room, or in a sleeping car.

Berth, Ship's, Self Leveling.
Huston . . "*Scientific American*," xlii. 341.
Berth, Swinging.
Andrews . . * "*Scientific American Supplement*," 125.
Couch, Equilibrio.
Anderson . . * "*Scientific American*," xxxvii. 134.

2. A position occupied by a vessel alongside a quay or wharf.

Be-si-clom′e-ter. (*Optical.*) An instrument which indicates the proper breadth of spectacles

Fig. 300.



Besiclometer.

between hinges; that is to say, the breadth of the forehead.

Bes′se-mer Steel. (*Metallurgy.*) Steel made in convertors from cast iron. A blast of air is driven through the molten metal to oxidize the carbon and silicon. Spiegeleisen is added to remove oxides. See pp. 277, 2364, 2365, "*Mech. Dict.*"

"At the period of the Crimean war, the British annual production of all kinds of steel was only about 50,000 tons, but immediately after the close of that war the Bessemer process was invented, and in 1878 no less than 850,000 tons of steel were made by it alone in Great Britain.

"The production of Bessemer steel in all countries in 1879 was about 2,700,000 gross tons of ingots and 1,900,000 tons of rails.

Country.	Ingots. Gross tons.	Rails. Gross tons.
United States	829,439	610,682
Great Britain	834,711	520,231
Germany	450,000	350,000
France	250,000	225,000
Belgium	100,000	75,000
Austria	100,000	75,000
Russia	50,000	40,000
Sweden	20,000	None.
Total	2,634,150	1,895,913

"There are eleven establisbments in the United States for the manufacture of Bessemer Steel — one in New York, five in Pennsylvania, one in Ohio, three in Illinois, and one in Missouri; all of these, except the last, were in operation in 1878. Each establishment has two convertors." — *Hon. D. J. Morrell.*

See *A. L. Holley's* report of Group I., "*Centennial Reports*," iii., pp. 35–37.

"The Bessemer practice of the United States is not equaled by that of any other country in the world. Even Great Britain falls far behind it. With 114 convertors, a majority of which may be presumed to have been active, that country produced in 1878 only 850,000 tons of ingots; while the United States in the same year, with 22 convertors, not all of which were active, produced exactly 653,773 English tons of ingots.

"The firm of Brown, Bayley & Dixon, of Sheffield, England, exhibited at the Paris Exposition, 1878, a rail 130′ long, rolled direct from the ingot, and bent into four lengths of 32′ each, the whole measuring 4½′ across." — *Hon. D. J. Morrell.*

The following may be consulted: —

Bessemer, Account of . . . "*Sc. Am. Sup.*," 3881.
Convertor bottom, *Jones* . . * "*Iron Age*," xx., Nov. 1, 5.
Bessemer's Inventions . . . "*Sc. Am.*," xxxix. 372.
Ladle stopper, *Lance*, Br. . * "*Engineer*," xlvii. 243.
Bessemer plant
Brown, Bayley & Dixon, Br. * "*Engineer*," xlv. 242.
Cambria Iron Works . . * "*Engineering*," xxvi. 107.
Cleveland . . . . . * "*Engineering*," xxii. 404.
Edgar Thomson Co. . . . "*Iron Age*," xvii., Jan. 13, 23
Holland . . . . . * "*Sc. Am. Sup.*," 1970.
Basic process, *Holley* . . . * "*Engineering*," xxx. 403.
Vulcan Iron Co., St. Louis. * "*Engineering*," xxiii. 183, 208.
"*Iron Age*," xviii., July 13, 15.
Bessemer steel, "*Times*" . "*Van Nostrand's Mag.*," xviii. 239.
Steel apparatus . . . . * "*Sc. Amer.*," xli. 127.

Bé′ton. The aqueduct from La Vanne to Paris, 135 miles long, is nearly entirely of *béton Coignet.* The Fontainebleau section of 37 miles, over dry quicksand, is composed of a series of arches, some of them 50′ high. Eight or ten

bridges of span from 75′ to 90′ are also of *béton*. For foundation and gravel walls, the composition is, sand 2½, gravel 2½, hydraulic lime 1, Portland cement ¼. For pillars, abutments, etc., sand 4, hydraulic lime 1. The other portions, sand 4, hydraulic lime 1, Portland cement ¼ to ½.

The ingredients are mixed in a dry state, then slightly moistened and ground in a mill that transforms it into a paste almost dry, which is then directly put into the molds. The latter are made of wood lined with sheet iron on the inside. The material is thrown into them by hand and stamped. As soon as the mold is filled it is turned out and left to dry for a few days, as it is only then that it will bear transportation. Compressed *béton* pipe is hard, compact, homogeneous, and resists a very high pressure. It has a smooth surface, so that the flow of the water is greatly facilitated. As this pipe is absolutely tight, filtration of noxious matter is impossible.

The Santorin *béton* used at Pola, was composed of Santorin earth — a volcanic product from the Greek island of Santorino — and common lime paste, in the proportion of 7 cubic feet of the former to 2 cubic feet of the latter, forming the hydraulic mortar; and to this was added 7 cubic feet of broken stone of the size usually employed in making concrete. The whole yielded a batch containing 9 cubic feet, was made into a conical heap, and tempered by open air exposure for a period varying from one day to three days, when the heaps were ready to be used under water.

General Q. A. Gillmore's Report on *Béton aggloméré*, or Coignet Béton, is the subject of a Report of the Corps of Engineers, U. S. Army, Washington, 1871, and contains full and detailed information on the subject.

Consult: —

Béton. . . . . * "*Manufact. and Builder*," x. 126.
Béton, Examples of . * "*Scientific American Sup.*," 1872.
Manufacture, *Goodridge* "*Scientific Amer.*," xxxvii. 201.
Repairing with, *Goodridge* "*Scientific American Sup.*," 1509.
Under water . . . . "*Scientific American*," xxxvi. 246.
Fountain in Prospect Park, Brooklyn.
* "*Sc. Am.*," xxxviii. 215.
Aqueduct of La Vanne. * "*Sc. Am.*," xxxiv. 194.
* "*Sc. Am. Sup.*," 660.
Manufacture of Béton blocks, N. Y. Docks.
* "*Sc. Am. Sup.*," 364.

List of uses of Béton: fountains, arches, tunnels, foundations, buildings, piers, floors, etc. * "*Sc. Am. Sup.*," pp. 1872–74.

Bev'el. An instrument with a handle and adjustable blade, the latter, in the example shown, being secured at any angle by a peculiar arrangement. By moving the thumb-piece at the lower end of the handle the longer lever acts upon the shorter one, which latter, being attached to a nut inside the upper end of the handle, operates as a wrench to turn it upon the screw, and thus fasten or release the blade.

Fig. 301.

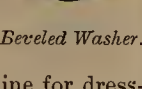
Bevel.

Bradshaw's bevel, * "*Sc. Amer.*," xxxv. 338.

Bev'eled Fur'ni-ture. (*Printing.*) The *side-sticks* and *foot-sticks* used in *imposing* forms or *locking up* galleys; beveled (tapered) pieces of wood or metal, less than type high.

Fig. 302.

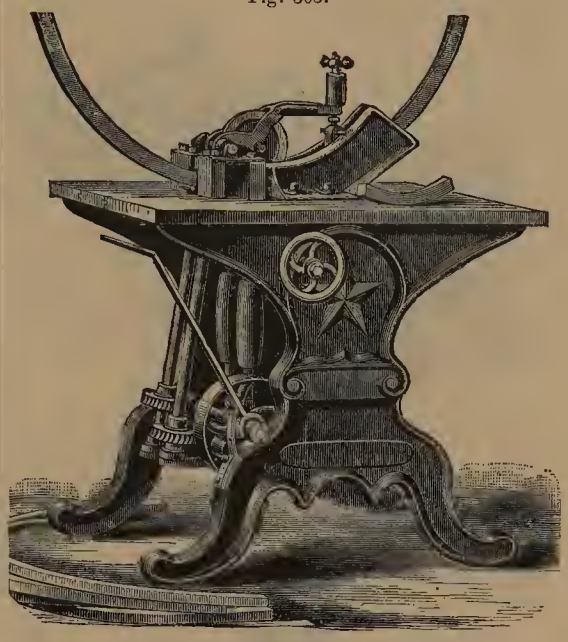
Bev'eled Wash'er. A washer with an upper face oblique with the base, so that a nut with oblique presentation may seat itself squarely upon it.



Beveled Washer.

Bev'el Fel'ly-pla'-ner. A machine for dressing the sides of fellies or bent rims, either square or beveling. It has a strong feed, easily regulated, and is adjustable for different sizes of fellies, and

Fig. 303.



Bevel Felly-planer. (*Fay & Co.*)

from square to bevel work. It bevels the rims before they are rounded inside, ready for finishing by the sand belts.

Bev'el-gear' Cut'ting Ma-chine'. Corliss's bevel-gear cutting machine was shown in the Machinery Hall, Philadelphia, 1876, near the great beam-engine. See "*Centennial Report.*"

Grub's bevel-gear cutter was shown in the German section of the same Exhibition. See Gear Cutter.

Corliss . . . . * "*Engineering*," xxv. 288.
Corliss . . . . * "*Engineer*," xlii. 364.
Corliss . . . . * "*Sc. American Sup.*," 783.
Corliss . . . . . * "*Sc. American Sup.*," 369.
Anton, Fetu & Deliège, Belg. * "*Engineering*," xxvii. 195.

Bev'el-head Bolt. A carriage bolt with a truncated conical head, as seen in Fig. 304.

Fig. 304.

Bevel-head Bolt.

Bev'el Hub. A form of bent pipe connection. See Hub, Bend.

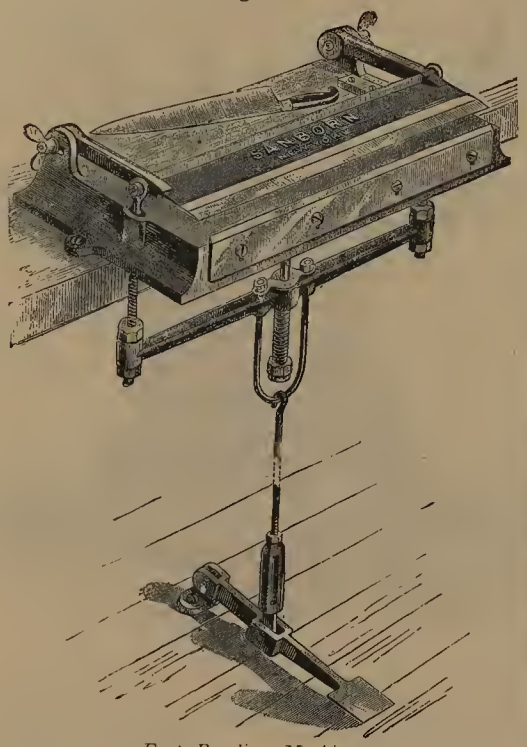
Bev'el-ing Ma-chine'. 1. (*Stereotyping.*) A machine for dressing off and beveling the edges of stereotype and electrotype plates equally on all sides, and parallel to the matter. The edge of the printing matter is placed against an adjustable side gage, secured in this position by clamps, and passed quickly before the revolving cutter, a stationary cutter at the same time taking off the sharp corner from the under edge of the plate. The table can be adjusted in height and also inclined to give a bevel more or less acute, and the revolving cutter-head is adjustable horizontally to suit the position of the table. A brass cover over the cutter prevents the chips from flying, and drops them into a box below.

2. (*Bookbinding.*) A clamp for holding binders' boards while being beveled by the knife.

In Sanborn's machine, Fig. 305, the board is placed between the jaws, and the upper jaw brought down by the treadle to clamp and hold the board. The board is adjusted by back and front gages. The paring knife has the two metallic edges to guide it.

Fig. 306 is Hoe's machine for the same purpose.

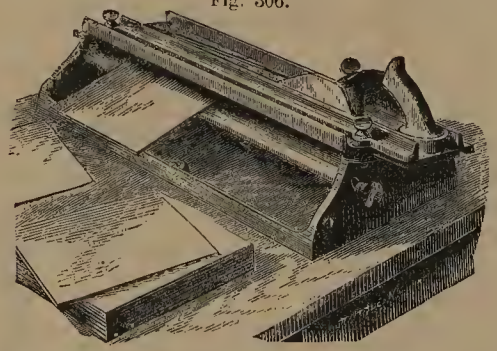
Fig. 305.



Foot Beveling Machine.

It is of metal. The plane runs in an oblique channel so as to use the whole edge of the knife, and give a shearing cut to the board. The table is

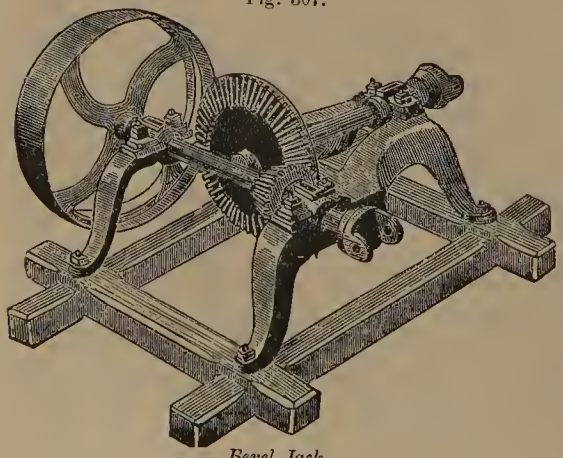
Fig. 306.



Beveling Machine for Binders' Boards.

adjustable to give any required bevel. The front gage or stop is formed by the farther edge of the groove; the end gage is movable on the table.

Fig. 307.



Bevel Jack.

Bev'el Jack. An intermediate gearing between a prime motor and a machine to be driven, when the motion of a tumbling rod is to be communicated to a band, and thereby to the machine.

In the *bevel* jack the gearing is by bevel-wheel and pinion.

In England called an *intermediate motion.*

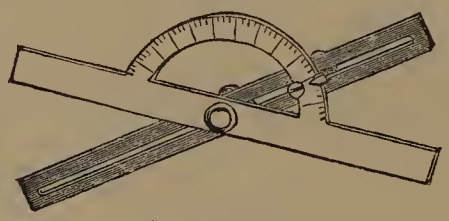
Bev'el Joint. A miter or sloping joint, the faces being dressed to an angle, usually of 45°.

Bev'el Pla'ter. A mill for rolling bevel-edged circular plates. The thickness is decreased from a center circle to the edge; such plates being used for shingle and veneering saws.

Jepson . . . . . "*Scientific American Sup.*," * p. 89.
Pedder & Abel . . . "*Scientific American Sup.*," * 714.

Bev'el Pro-tract'or. A drafting instrument

Fig. 308.

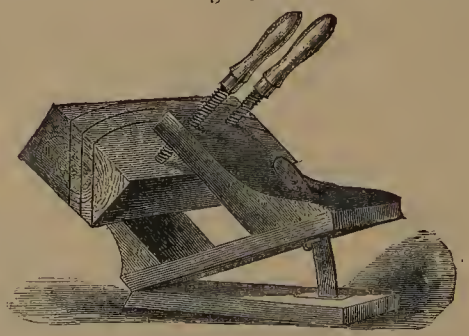


Bevel Protractor.

with a pivoted sliding arm, which has a semi-circle divided to degrees. Fig. 308.

Bev'el Rest for Band Saw Cut'ting. A

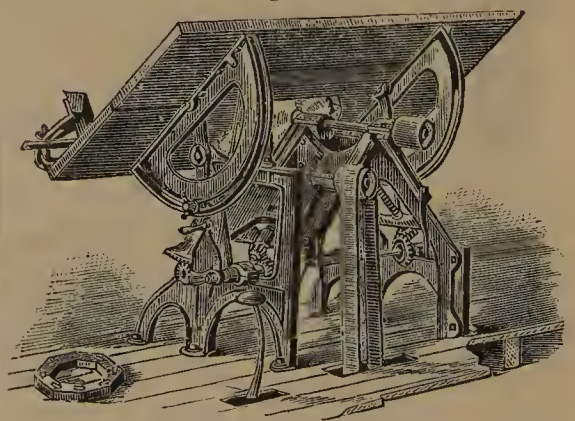
Fig. 309.



Rest for Bevel Cutting with Band Saw. (Arbey, Paris.)

holder for stuff on the band-saw table, capable by arc adjustment of being inclined so as to present the stuff obliquely to the table base to be split at any angle by the saw.

Fig. 310.



Bevel Sawing Machine.

Bev'el Saw'ing Ma-chine'. A machine the table of which has underneath sector adjustment,

so as to be set at any inclination, and present the stuff to be split obliquely by the saw.

See also Band Saw, Fig. 196 *supra*, and Plate III., opp. p. 76; also Bevel Scroll-saw, p. 279, Fig. 669, "*Mech. Dict.*"

Bi'ar-etz. (*Fabric.*) A French goods, warp and weft of merino wool, and woven with a corded or cannel armure.

Bi'as Meas'ure. A graduated measure with

Fig. 311.

Bias Measure.

ends at angles of 45° with the base, to assist in measuring and marking off or cutting goods to be "cut on the bias."

Bibb. A bent-nosed faucet.

Plumbers catalogues cite many varieties: three are shown in Fig. 672, p. 280, "*Mech. Dict.*" Others are known as —

Plain Bibbs,	Compression Bibbs,
Hose Bibbs,	Telegraph Bibbs,
Wash-tray Bibbs,	Bath Bibbs, etc.

Biche'roux Fur'nace. (*Metallurgy.*) One form of Gas-generating Furnace, which see.

May consult: —

"*Engineering and Mining Journal*,"	* xxi. 55; xxiv. 362.
"*Scientific American Supplement*,"	* lxxxviii. 1331.
"*Iron Age*"	* xvii., Jan. 13, p. 24. Jan. 29, p. 1.
"*Engineer*"	* xlvi. 91.

Bi-chro'mate Bat'te-ry. (*Electricity.*) One in which bichromate of potash with dilute sulphuric acid is used as an exciting fluid.

Grenet's is a familiar instance, having a zinc element between two carbons.

Prescott's "*Electricity*" . . .	* p. 72
"*Niaudet*," American translation . .	211, * 223.
"*English Mechanic*"	xxiii. * 12, *466.
Simple form of.	"*Sc. American Sup.*," * 2263.
Erck, "*Scientific American*" . . .	xl. 169.
Ergström, "*Sc. American Sup.*," . .	3791.
McCarty. "*Sc. American Sup.*," . .	3791.

Bi'cy-cle. A two-wheeled vehicle, the *ultima ratio* of the old velocipede.

The "Paragon" may serve as an example. The spokes are of wire, and on the spider-web principle, each spoke having an independent tension. The fellies are of angle iron, the angle holding the round hoop of caoutchouc, $\frac{7}{8}''$ diameter, which is secured by cement. The backbone is tubular; the front wheel runs on conical bearings.

The pedals are of two kinds: wooden blocks with steel bushes and pins, and oval or triangular pedals composed of steel pins, mounted in brass, and covered with India-rubber.

The handles are of rosewood, ebony, or ivory, upon a steel rod, the support of polished gun-metal, level with the top of the socket, an arrangement found to render it easier to mount and dismount, and giving more command over the machine generally, both in ascending hills and on the level.

Leg-rests are of two kinds, one of which is fixed to the front fork, folding up when not in use, and the other over the front wheel.

The saddle is placed as near the wheel as practicable, to enable a rider to use a machine with wheels as high as possible.

Turner, Eng.	* "*Sc. American Sup.*," 1999.
English	* "*Sc. American Sup.*," 856.
	"*Sc. American Sup.*," 1283.
"Columbia"	* "*Sc. American*," xl. 35.
	* "*Sc. American Sup.*," 2585.
Garrood	* "*Sc. American Sup.*," 1569.
Manufacture	* "*Sc. American*," xlii. 181.
Otto	* "*Sc. American*," xxxix. 42.
"Paragon," "Ariel," etc.	* "*Sc. American Sup.*," 1160.

Bi-cus'pid For'ceps. (*Dentistry.*) Forceps

Fig. 312.

Forceps for Upper or Lower Bicuspids.

with moderately narrow curved beaks, adapted for the extraction of bicuspid teeth.

Bi-det'. A wash-pan, having special uses.

Bid'i-ri. (*Fine Art Metal Working.*) A species of damascening or inlaying upon an object made of an alloy of copper, lead, and tin, blackened by dipping in a bath of sal-ammoniac, saltpeter, salt, and blue vitriol. Named from Beder in Hyderabad.

Big'gin. 1. A hood or cap.

2. A percolator or strainer for holding coffee while boiling water is poured through it.

3. (Welsh, *pigyn*; Gaelic, *pigean*.) A small earthen pitcher or pot.

Bil'let. (*Harness.*) 1. A short strap punctured with holes and attached to various parts of the harness; used for connecting by a buckle different straps and portions.

2. (*Metallurgy.*) A bloom or loup of iron in the furnace or mill.

Bil'liards. See

Billiard cushion rail.	*Collender.*	* "*Sc. Am.*," xxxvii. 147.
Billiard table . . .	*Collender.*	* "*Sc. Am.*," xxxvii. 22.
Billiard table leveler	*May.* .	* "*Sc Am.*," xxxv. 211.
Billiard table manufacture . .		* "*Sc. Am.*," xl. 302.

Bind. (*Mining.*) Derbyshire: indurated clay.

Bind'er. 1. A binding reaper. See Reaper; Reaper and Binder.

2. A machine for binding gavels left in the swath by a reaper.

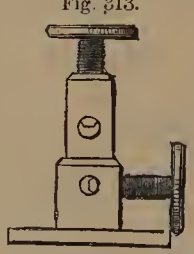
Fig. 315 shows a one-horse machine, having a gathering-rake in front which passes beneath the gavel, raises it by the assistance of a rake reel, and discharges it on to a rear platform, where it is bound, and from whence it is discharged. The machine follows in the wake of a self-raking reaper.

3. An implement to assist in hand-binding of sheaves. See Sheaf Binder.

4. (*Mining.*) A piece of iron attached to a truck or barrel, and to which the pit rope is fastened.

Bind'ing Post. (*Electricity.*) A device with a screw, which secures the end of an electric wire.

Fig. 313.



Binding-post.

Fig. 314.

Binding-screw

The examples are a double table binding-post, Fig. 313, and a binding-screw, Fig. 314.

Bi-noc'u-lar Tel'e-scope. Ponti's (Venice) portable binocular telescope consists of two conjoined parallel telescopes of equal power and length of focus. The object-glass and tube of each are square, and each tube has a micrometer screw for the adjustment of the

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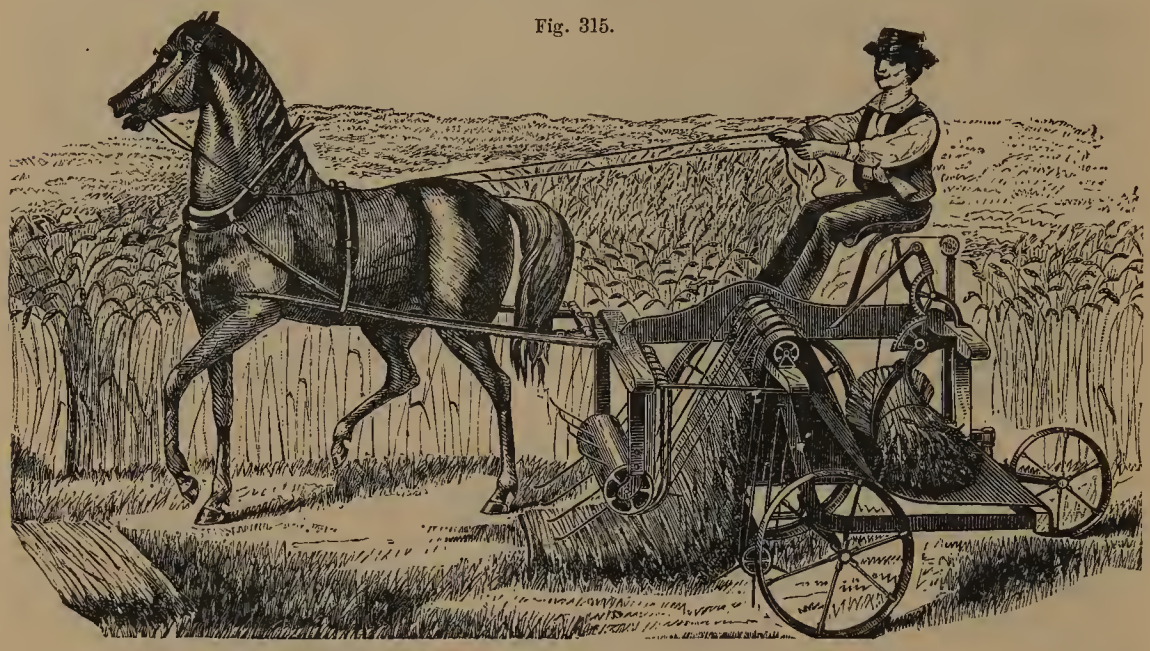
Fig. 315.



Johnston's Sheaf Binder.

focus. The square form permits the eye-pieces to be brought to the same distance apart as the axes of the eyes of the observer.

Binocular microscope.
Molera & Cebrian . . . *"*Sc. American Sup.,*" 3869.
Binocular vision . . . . . "*Sc. American,*" xxxvi. 20.

Bi'o-scope. A double-vision instrument. In a recent invention of M. Eugène Simmonar, a portrait is shown with the eyes sometimes open, sometimes shut. The illusion of the same person alternately awake and asleep is very perfect. To obtain this effect, the inventor takes a double photograph of a sitter in exactly the same position, only in the first the eyes are open, in the second closed. From these two negatives prints are taken, one on the right side, the other on the reversed side of the same sheet of paper, in such a way that the two images, when viewed by transmitted light, accurately coincide; this can easily be done by the carbon process. By means of a small instrument arranged for the purpose, the light and reversed sides of the paper are alternately illuminated, and the face is seen with the eyes successively open and shut. Thus the illusion of a person rapidly winking can be perfectly produced.

Bird Foun'tain. A drinking vessel for birds, on the principle of the fountain inkstand.

Bis'cuit Ma-chine'. A machine for making crackers, biscuit, etc. See Cracker Machine.

Bi-sec'tor. (*Surgical.*) A lithotomic instrument used in connection with a grooved staff in cutting the prostate gland in operating for stone in the bladder.

Fig. 133, p. 38, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Bis'muth Al-loy'. A careful statement of the character and uses of various bismuth alloys is to be found in *"Guettier's Metallic Alloys."* Copied into *"Polytechnic Review,"* and also into *"Engineering and Mining Journal,"* xxii., p. 137.

Bismuth extraction process. *Painter's "Report Vienna Exposition,"* iv. 94.

Bis'muth Bronze. An alloy composed as follows: —

	Hard Bronze.	Soft Bronze.
Bismuth	1	1
Lead	3	5
Zinc	6	12
Nickel	15	30
Copper	25	52
Antimony	50	—

"*London Mining Journal.*"
See also "*Mining and Sc. Press*" . xxxv. 339.

Said to withstand oxidation, and to be particularly suitable for the preparation of lamp reflectors.

Bi-soc'. (*Agriculture.*) The French name for a two-furrow plow, or gang plow with two bodies. See Gang Plow.

Bis'tou-ry. (*Surgical.*) A small surgical knife. Fig. 692, p. 287, *"Mech. Dict."*

The figures ensuing refer to the pages in *Tiemann's "Armamentarium Chirurgicum."*
The *bistoury caché* has a concealed knife. Fig. 49, Part II., and Figs. 76, 584, 591, Part III.
Staphylorrhaphy Bistouries, pp. 66, 67, Part II., and p. 10, Part V.
Tenotome, p. 61, Part I.
Sharp-pointed Bistouries, pp. 6, 46, 56, Part I.
Probe-pointed Bistouries, pp. 6, 46, 56, Part I.
Hernia Bistouries, pp. 6, 46, 56, Part I.
Finger Bistouries, pp. 6, 46, Part I.
Ear Bistoury, p. 46, Part II.

Bi-sul'phide of Car'bon Ap'pa-ra'tus. In addition to the reference to the Ellis engine, p. 287, *"Mech. Dict.,"* consult Engl. Pat. 11,615 of 1847. Two engines, one worked by steam, the other by vapor of ether, etc. The exhaust steam of one engine vaporizes the ether of the other.

No. 11,625 additional thereto.
No. 96 of 1854, uses bi-sulphide of carbon.
Pecoul, No. 1,008 of 1855, spiral tubes containing steam are coiled in each end of the cylinder.
Sulphuric ether is injected into each end of the cylinder alternately and vaporized in the tubes.
2,768 of 1853 mixes vapor of ether with air.
See also: —
Bi-sulphide of Carbon Apparatus.
* "*Mining and Scientific Press,*" xxxvi. 337.
Bi-sulphide of Carbon Engines.
"*Manufacturer and Builder,*" xii. 110.
Bi-sulphide of Carbon Motors, Eng.
"*Iron Age,*" xxv. February 5, p. 15, March 25, p. 11.

Bit. (*Manége.*) The variety of bits used in England much exceeds our knowledge of the manége. The following are those on sale: —

Breaking bits.	Spring hooks and snaffles.
Van and cab bits.	Regulation officers' tee pa-
Wilson snaffles.	droons.
Snaffles and bits, polished,	Slabbering bits.
tinned, or galvanized.	Ladies' riding bits.
Hackney bits and bradoons.	Hanoverian bits.
Pelhams.	Australian ring snaffles.
Gig bits.	Indian snaffles and bits.
Buckstone, or fancy-cheek	Hackney curbs.
carriage bits.	Carriage curbs.
Carriage swivel bradoons.	Gig curbs.
Stallion bars and chains.	

A French electric bit is thus arranged: The coachman has under his seat an electro-magnetic apparatus, which he works by a little handle. One wire is passed through the rein to the bit and carried to the crupper, so that a current once set up goes the entire length of the animal along the spine. A sudden shock will, it is stated, stop the most violent runaway.

Bit Brace. A crank handle for working a bit. Figs. 856–858, p. 353, "*Mech. Dict.*"

Bit-stock . . *De Bert* . . * "*Sc. American*," xli. 18.

Bit'-brace Die. A screw-cutting die set in the end of a bit to be worked by a brace. Fig. 316. The tool is useful for re-dressing bolts, clips, staples, etc., that have lost nuts, when set in wood-work where it is desirable to cut them without removal or marring paint; also, for cutting stove rods and small bolts, in tin-shops and elsewhere. The collets, of malleable, iron, measure in their largest diameter 1½″. The dies are made of one piece of steel, split on one side, held in position in the collet and adjusted by three screws.

Fig. 316.

Bit-brace Die.

Bit Stand. A turned piece of wood with perforations in which bits may be stuck to keep them in order and ready for use. For dentists' purposes principally.

Bit Strap. (*Manége*). A short strap used to attach the bit to a short cheek bridle, or to a halter.

Bit'ting Har'ness. (*Manége.*) A harness consisting of a plain halter, a girth with wooden uprights placed in the center of the pad and set at an angle, and leather reins with rubber web ends. Rings are attached to the uprights and sides of the girth, into which the ends of the reins are buckled after being passed through the ring of the bit. Used for breaking colts to the bit. Also called breaking harness.

Bi'valve Spec'u-lum. (*Surgical.*) One having two leaves or flaps.

The figures refer to *Tiemann's "Armamentarium Chirurgicum."*

Bivalvular Anal Speculum, p. 118, Part III.
Bivalvular Ear Speculum, p. 34, Part II.
Bivalvular Nasal Speculum, p. 55, Part II.
Bivalvular Vaginal Speculum, pp. 60, 66, Part III.

Black-ba'salt Ware. (*Ceramics.*) One of the contributions of the admirable Wedgwood to the Ceramic art. Invented by him in 1766. It is a fine black ware, choice, and an *article de luxe.*

Black Brick. Bricks colored by heating red-hot, and dipping the exposed surface into a pan containing half an inch or so of melted coal-tar. Soft bricks are the best. "*American Architect.*"

Black Flux. Composed of 7 parts of crude tartar, 6 parts of saltpeter, 2 parts of common bottle glass, and by some a small amount of calcined borax is added. These ingredients are first finely pounded and mixed, and then gradually heated in an iron pot or ladle so as to burn them together. Care should be taken to not overheat the mixture, and as soon as it is thoroughly melted and mixed together it should be removed from the fire and allowed to cool. After it has cooled it is finely pulverized and sifted, and is then ready for use.

Black Glass. The black glass made in Venice is famous for the intensity of its color. M. Kayser, a Nuremberg chemist, has ascertained by analysis that manganese is the substance used. To confirm this result, he melted in a small furnace a mixture of sand and sulphur, in which he introduced 15 per cent. of peroxide of manganese. He thus obtained a glass of a deep black color; in very fine threads or thin splinters it was of a sombre violet.

Black'ing. 1. For Iron Castings: —

Common. — Coal tar.
Finer. — Japan varnish.
Work exposed to heat. — Graphite.
Work exposed to weather. — Black varnish, dusted with dry graphite, and brushed.
Ornamental Castings. — Heat to blue annealing heat, coat with black copal varnish, and dry at same heat. To polish, give another light coat, and heat moderately.
Mantels. — Enamel varnish.
Lead-color Paint. — Oxide of lead heated in a pot, and flower of sulphur and oil stirred in.

2. For Leather: —

Harness and Bridle Leather. — A decoction of iron-rust and vinegar, or iron-rust and sour wine or sour beer, applied to the grain side of the leather after it has been stained. The vinegar solution is the best. After this application the leather is said to be *blacked on the grain.*
Wax Leather, — A compound of lampblack and soft soap, laid on the flesh side with a brush. The skin is now said to be *blacked on the flesh*, or *waxed.*

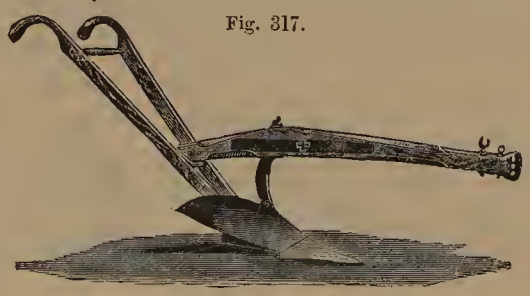
3. (*Founding.*) Charcoal in fine powder dusted from a bag on the mold or applied as black wash.

Black'ing Bag. (*Founding.*) A linen bag from which ground charcoal is dusted on to the surface of a mold.

Black'ing-box Press. A sheet-metal press expressly for cutting and drawing blacking-boxes and covers. See Stamping Press.

Black'-land Plow. A light, one-horse, 7″ cut, steel plow. The model of its mold and share

Fig. 317.



Avery's Black-land Plow.

is low, long, and narrow, and it is designed expressly for the black, waxy prairie lands of the south.

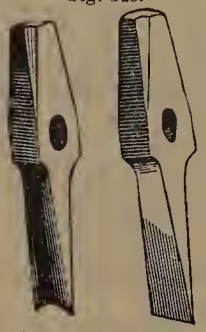
Black Lead. Properly, *graphite.* It is used sometimes for mixing with sand, and for blacking molds; also frequently for polishing patterns to prevent adhesion. It exceeds all other carbonaceous matter in incombustibility. The uses of graphite are multifarious; for pencils, crucibles, polish, lubricant, electrotyping, etc., see Graphite, page 1010, "*Mech. Dict.*"

Black Mor'tar. Take good fat lime, and use no sand, but mix it with fine coal-dust instead of sand. Merely to paint the joints black, mix lampblack with boiled linseed oil. In the first case it is put in place with the pointing tools; in the second

case, it is applied by the particular kind of brush used by house-painters for that purpose.

Black'smiths' Chis'el. A hammer-shaped tool with one sharp edge, and used in cutting iron by a blow delivered with a hammer.

Fig. 318.



Blacksmiths' Chisels.
(a.) Gouge chisel.
(b.) Hot chisel.

Black'smith's Lathe. A lathe of moderate size, adapted especially for performing repairs in workshops and factories. A special lathe for this purpose turns 12″ in diameter over shears, is arranged to be driven by steam, water, horse or hand-power, is self-acting, with means of varying the feed, and can be employed for turning, boring, or drilling, as occasion may require.

Black'smith's Sledge. A heavy hammer wielded by the blacksmith's helper, and having a cross or straight peen.

Fig. 319.

Blacksmith's Cross-peen Sledge.

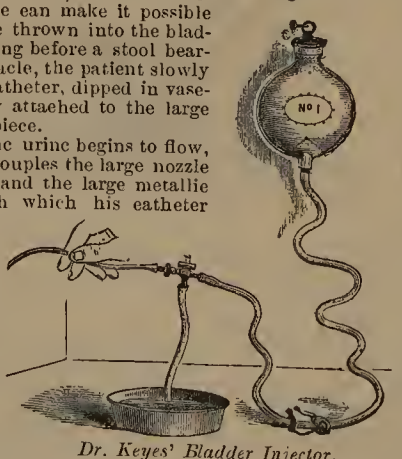
Black Wash. (*Molding.*) A fluid application to the surface of dry sand molds, loam molds and cores, consisting of very thin *clay wash*, with an addition of powdered charcoal. When dried it forms a thin layer, which prevents *sand burning*, and gives a clear skin to the casting, performing the same function as *blacking dust* on green sand molds. It is also used as a *parting* in loam molding.

Blad'der In-ject'or. An instrument to wash out the bladder. It consists of a soft rubber catheter, with injection apparatus and valves.

The instrument may be described by a detail of the manner in which the patient uses it.

He prepares eight ounces or more of the injection fluid at a temperature of 110° F. The bag, filled with the warm fluid, is hung up about 6′ from the floor. The stopcock is now turned on till all the air is forced out of the tube and a jet of water follows. The instrument is now charged for use, and no subsequent disturbance can make it possible for any air to be thrown into the bladder. Now, standing before a stool bearing some receptacle, the patient slowly introduces his catheter, dipped in vaseline, and already attached to the large metallic mouth-piece.

Fig. 320.



Dr. Keyes' Bladder Injector.

As soon as the urine begins to flow, he immediately couples the large nozzle of the stopcock and the large metallic mouth-piece with which his catheter has been provided, and the urine flows promptly through the short rubber tube into the vase on the stool before him. When the urine has escaped, he turns the stopcock and the bladder slowly fills. As soon as the organ begins to feel distended, he turns the stopcock again. The simple motion of turning a stopcock does not communicate the slightest jar to the neck of the bladder, while the water flows in and out of the body, obeying the natural law of gravitation, so slowly and quietly that the patient scarcely perceives it.

He may thus wash his bladder very thoroughly four, five, or six times, without any change of the instrument or its adjustment, except the simple turning to and fro of a stopcock; and this he does until the water flows comparatively clear from his bladder.

Blad'der In'stru-ments. (*Surgical.*) These are of various kinds, not including those for operating for stone in the bladder, lithotomic, lithotritic, lithoclastic instruments.

The figures refer to *Tiemann's "Armamentarium Chirurgicum."*

Bladder evacuating apparatus . . .	pp. 37, 44, Part III.
Extrophy (inverted bladder) apparatus	p. 47, Part III.
Puncturing apparatus; trocars . . .	p. 30, Part III.
Tapping apparatus; aspirator . . .	p. 30, Part III.
Washing apparatus; syringes, catheters, etc.	p. 44, Part III.

Blan'ket Rif'fle. A blanket is taken and cut into strips, and these strips sewed together so as to fit into the sluice under the settler. The edges of the strips of blankets then form a series of riffles for catching quicksilver, gold, and sulphurets. The blanket riffles are about 6″ apart.

Under the blanket are several half oval bars of iron flat side down, which extend longitudinally through the sluices, and are fastened together. A bell crank motion moves these bars laterally back and forth under the blanket riffles, and they serve to keep the material gently stirred up so that the tailings will flow off readily. By this lateral motion of the bars under the blanket, the pulp is prevented from packing. The edges of the blanket riffles are of the best form for catching gold and quicksilver, and the blankets can be taken out and washed, or eventually burned in the usual way.

Blank Flange. A round plate to be bolted on the flanged end of a pipe to close the aperture.

Blank'ing Press. A stamping press for simply cutting out blanks.

Blank'-work Fold'er. A paper-folding machine, especially adapted for folding blank-work in sections, quires, or single sheets.

Blast Fur'nace. (*Metallurgy.*) One depending upon a column of air *driven into* it by mechanical means, as distinguished from an *air* furnace or *wind* furnace, which depends upon chimney draft. *Plenum* and not *vacuum.*

"The number of blast-furnaces in the United States is now 700, of which not quite 300 were in blast in 1877 and 1878." — *Morrell.*

See the following references: —

Blast Furnaces.

At Bessemer, Ill. .	* "*Engineering*," xxi. 462, 486.
Batty	"*Scientific American Sup.*," 327.
Bethlehem, Pa. . .	* "*Iron Age*," xx., Nov. 8, p. 1.
	* "*Scientific American Sup.*," 1475.
	* "*Engineering*," xxiv. 159, p. 163.
Buttgenbach, Prussia	* "*Blake's Report, Vienna Exposition*," iv. 82 +.
Carinthian	* *Ibid.*, * iv. 21, *et seq.*
Cedar Point . . .	* "*Engineering*," xxiv. 465.
Clausthal	* "*Engineering*," xxiv. 140.
Durham, Pa. . . .	* "*Engineering*," xxvii. 150.
Hof, Bavaria . . .	* "*Engineering*", xxiv. 101.
Japanese	"*Iron Age*," xvii. April 20, p. 15.
Lonsdale, Br. . . .	* "*Engineering*," xxii. 462.
"Luey Iron Works"	* "*Engineering*," xxvi. 410.
"Luey," Ironton .	* "*Engineering*," xxviii. 162.
Mariazell, Styria .	* "*Blake's Report, Vienna Exposition*," iv. 43 +.
Meier Iron Co., Ill. .	* "*Engineering*," xxvii. 315.
Of Great Britain . .	"*Scientific American Sup.*," 287.
On the form of . .	"*Iron Age*," xvii., April 13, p. 7.
Stephens	* "*Iron Age*," xx., Nov. 15, p. 5.
Warwick	"*Iron Age*," xxii., July 11, p. 26.
Weimer	* '*Engineer*," xiii. 235.
Furnace Charger . .	* "*Scientific American Sup.*," 197.
Weimer & Berkenbine	* "*Engineering*," xx. 97.
	* "*Polytechnic Rev.*," ii. 70.
Williamson, Br. . .	"*Iron Age*," xxi., July 26, p. 20.
Furnace Feeder, *Moore*	* "*Iron Age*," xx., October 18, p. 5.

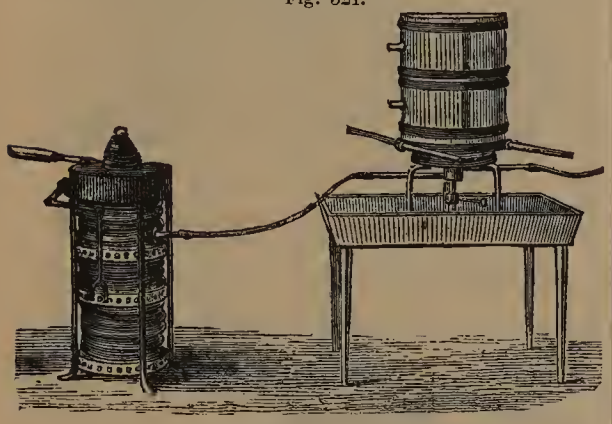
Furnace Fuel, Anthracite.

Lebanon, Pa. . . .	* "*Engineering*," xxiv. 286.
	* "*Scientific American Sup.*," 1605.
Hydro-carb., *Cassell*	* "*Iron Age*," xix., Feb. 22, p. 5.

Liquid Fuel . . . * "*Scientific American Sup.*," 47.
Natural gas . . . * "*Iron Age.*" xxvii., Feb. 17, p. 1.
Petroleum in, Belg. "*Scientific American*," * xxv. 83.
Furnace Hearth.
Lurmann . . . . * "*Eng. and Min. J.*," xxi. 128.
Furnace Lines.
Hartman . . . . * "*Iron Age*," xxv., March 4, p. 1.
Blast Furnace Plant.
Crown Point, N. Y. . * "*Engineering*," xxv. 220.
Cambria Iron Works. * "*Engineering*," xxvi. 154.

Blast Gas Fur'nace. An apparatus used for the fusiou of refractory metals, etc.

Fig. 321.



Griffin Blast Gas Furnace.

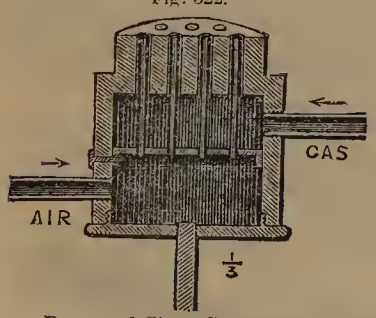
It has a particular form of gas-burner, which is supplied with gas at the usual pressure, and with a blast of common air, supplied by bellows or a blowing machine, at about ten times the pressure at which the gas is supplied.

The furnace is built up round the flame that is produced by the gas-burner, and the crucible that is exposed to ignition.

Fig. 321 shows the arrangement of the apparatus, Fig. 322 a vertical section of the burner, and Fig. 323 gives a horizoutal section of the burner.

The gas burner is a cylindrical iron reservoir, constructed as shown in Fig. 322. It contains two chambers, which are not in communication with one another. Into the upper chamber, gas at ordinary pressure is allowed to pass by the tube marked GAS. Into the lower chamber, air is forced by the tube marked AIR. The upper part of the burner is an inch thick in the metal. Through this solid roof holes are bored for the escape of the gas. The air passes from the lower chamber through a series of small tubes placed in the center of the gas-holes, and continued to the surface of the burner, so that the gas and air do not mix until both have left the gas-burner, and then a current of air is blown through the middle of each jet of gas. The bottom of the gas-burner is made to unscrew, and the division between the two chambers, which carries the air-tubes, is removable, for the purpose of being cleaned. The gas has usually had a pressure of 0.5″ of water, and the blast of air about ten times that pressure. The quantity of gas used in an hour is about 100 cubic feet.

Fig. 322.



Burner of Blast Gas Furnace.

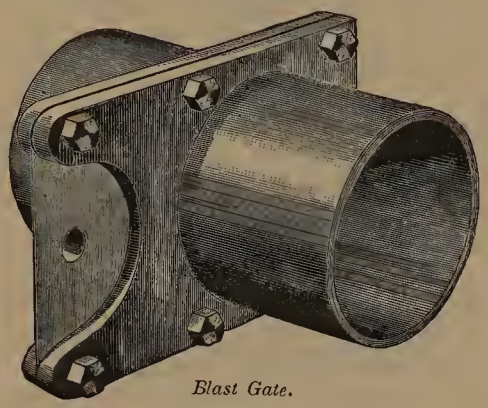
Fig. 323.

Section of Blast Gas Furnace.

When the gas is lighted and the blast of air is put on, the flame produced by the gas-burner is quite blue aud free from smoke. It is 2″ in diameter and 3″ high, and the point of greatest heat is about 2″ above the flat face of the gas-burner. Above this steady blue flame there rises a flickering, ragged flame, several inches in height, varying with the pressure of the gas. In the blue flame, thiu platinum wires fuse readily.

Blast Gate. The stop-cock or valved aperture of a blast-pipe.

Fig. 324.



Blast Gate.

Blast-heat'ing Stove. A stove or oven for heating air for blast furnaces.

Durham, Pa. . . . * "*Engineering*," xxvii. 151.
Lonsdale, Br. . . . * "*Engineering*," xxxii. 480.

Blast'ing. Rending by exploding substances.

Blasts . . . . . "*Sc. American*," xl. 391.
Blasting Cartridges . . "*Sc. American*," xxxiv. 391.
Blasting Explosives . . "*Sc. American Sup.*," 2018.
Blast at Hell-gate . . . "*Van Nostrand's Mag.*," xv. 476.
Blasting, Principles of . * "*R. R. Gazette*," xxii. 217, 229.
Dynamite under water . * "*Engineer*," xliii. 251.

Noted effective blasts: —

Gleudon Iron Quarry, Easton, Pa., 12,000 lbs powder, displacing 60,000 tons of rock.

Reservoir Ditch Co., Yuba Co., Cal., 50,000 lbs. Judson powder, displacing 250,000 tons of gravel.

Consult: —

Drinker's "*Tunneling, Explosive Compounds, etc.,*" New York, 1878.

Andre's "*Rock Blasting,*" London, 1878.

General Newton's Annual Report "*On Removal of Obstructions at Hell-gate,*" 1873-76.

Williamson & Heuer's "*Report on Removal of Blossom Rock.*"

General Burgoyne's "*Blasting and Quarrying of Stone and Blowing-up of Bridges.*"

Blast'ing Com'pound. Huetter's gun-cotton and nitrate of baryta.

"*Chemiker-Zeitung.*"
"*Scientific American Supplement*," 2800.
See, also, list under EXPLOSIVES.

Blast'ing Gel'a-tine. A new explosive agent, discovered by M. Nobel. This substance, called in England, "*Blasting Gelatine*," is formed by dissolving collodion cotton in nitro-glycerine in the proportion of 10 per cent. of the former to 90 per cent. of the latter. The result of the solution is a gelatinous, elastic, transparent, pale-yellow substance, having a density of 1.6, and the consistence of a stiff jelly. The new explosive is in itself much less easily affected by blows than ordinary kieselguhr-dynamite; but it may be rendered far more insensible to mechanical impulse by an admixture

of a small proportion (from 4 to 10 per cent.) of camphor. Experiments have been carried out, the result of which is to prove that the new explosive possesses, weight for weight, 25 per cent., and bulk for bulk, 40 per cent. more explosive power than ordinary dynamite. With moist gun-cotton, gelatine compares nearly as favorably.

See article by H. Baden Pritchard in "*Nature*;" reproduced in "*Scientific American Supplement*," 2869.
See, also, "*Engineering and Mining Journal*," xxvi. 271.

Blast Lamp. One with an artificially produced draft of air to aid combustion.

Lavender, * "*Engineer*," xlii. 309.

Blast Noz'zle. The opening of the blast-pipe at the foot of the smoke-stack of a locomotive.

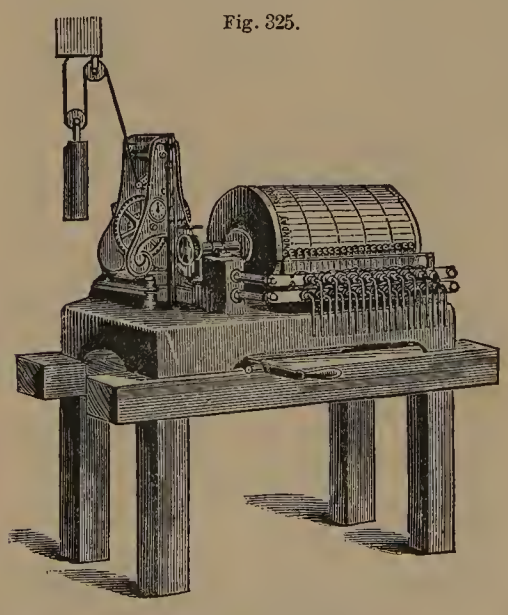
Annular, *Mallet*, Fr. . . . . * "*Engineering*," xxv. 221.
Annular, *Brown*, Winterthur . * "*Engineering*," xxv. 170.
Noise suppressor, *Aveling* . . * "*Engineer*," xlii. 41.
Shaw . . . * "*Engineer*," xlii. 41.

Blast-Re-cord'er. An instrument for keeping a record of the time a hot-blast oven is in blast. The ovens, of the Whitwell class, for instance, are used alternately, the work of each being intermittent, as is the case also with the Siemens' and Ponsard regenerators, and the punctual shifting of the blast to the respective sides of the twin stoves is important. See Regenerator, Gas Generating Furnace, etc.

In the illustration, Fig. 325, the recorder is adapted to indicate the performance of twenty-one pairs of ovens, each of which has its iron pencil which records the performance on the paper, in manner following: —

A pipe leading from the blast pressure terminates at a cross-bar opposite the drum, to which the pencil mechanism is fastened; when the blast comes on a small piston is caused to project forward forcing the pencil upon the paper; the joint

Fig. 325.



Bailey's Blast-Recorder

is made air-tight by means of an elastic diaphragm, about an inch in diameter. The diagram completes a revolution by clockwork once a week, and the number of hours worked by each oven can be at once seen by the length of the stroke which its pencil has made upon the paper.

See "*Engineer*" . . . . * xlv. 30.
"*Scientific American*" * xxxviii. 131.

Blast Reg'u-la'tor. Hoge's blast-governor, for grain separators, has a blast-regulating valve, automatically adjusted by means of another valve or piston suitably connected to it, the latter being actuated by the difference in pressure of the blast and the external air. Patent, No. 138,563.

Bleach'e-ry Boil'er. The bleachery boilers of Lawrie, of Glasgow, are shown in Fig. 241, Article "*Blanchiment*," *Laboulaye's "Dictionnaire des Arts et Manufactures*," Tome iv., ed. 1877.

See also Keir and Bucking Keir in "*Mech. Dict.*"

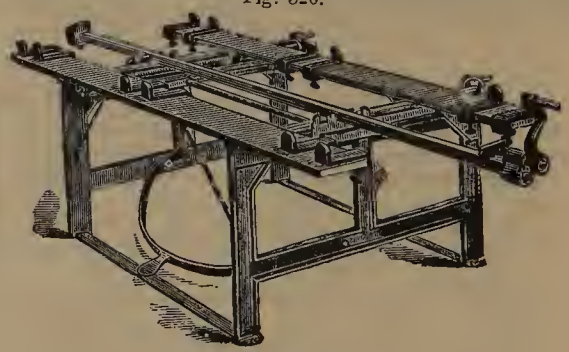
Blende. (*Mining.*) An ore of zinc, consisting of zinc and sulphur.

Blind. A window screen. Made in several forms: a series of slats strung upon cords; a window shutter with slats in the panels; a shutter of iron slats wound upon a roller and letting down in front of a store window to protect it at night.

Blinds, metallic.
Hayes . . . . . * "*Manuf. and Builder*," ix. 151.
* "*Manuf. and Builder*," x. 102.

Blind Clamp. A machine on which the parts of a blind are brought together and pressed into shape. In the example, Fig. 326, this is done by a single motion.

Fig. 326.



Blind Clamp.

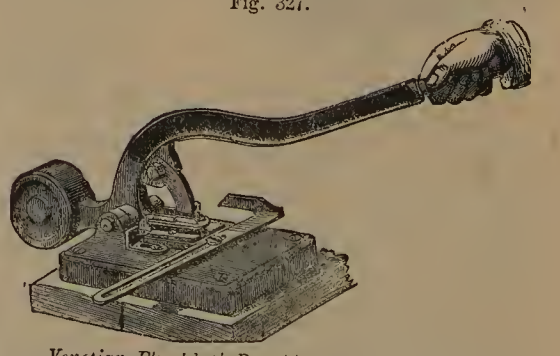
Carpenters' and joiners' clamps and similar devices for boxes, sash, doors, etc., are mentioned under their respective heads

Blind'-fast. The fastening of a blind or shutter.

Blind Ink. Invented by Edison. An ink which at first makes a grayish-white mark, but soon swells up into relief on the paper, so as to be traced by the touch of the fingers.

Blind'-lath Punch'ing Ma-chine'. A machine for perforating the slats of Venetian blinds for the running cord by which they are adjusted.

Fig. 327.



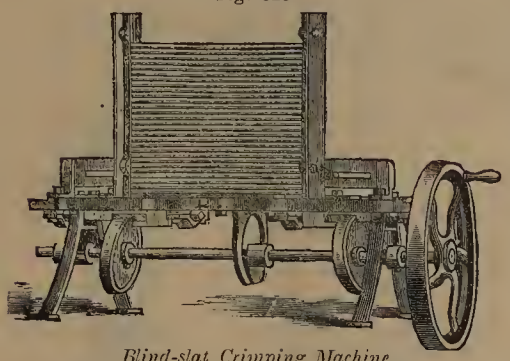
Venetian Blind-lath Punching Machine. (*Eng.*)

Beneath the lever is a curved cutter, oblong in section, like the opening to be punched. See Fig. 327.

Blind'-rel'ish-ing Ma-chine'. See SASH-RELISHING MACHINE.

Blind'-slat Crimp'ing Ma-chine'. A machine used for compressing the ends of stationary blind slats so as to fit and fill the mortises. It may be operated by hand or power. The slats are placed in a hopper, or receiver, at the top of the machine, and the rotary motion given to the balance wheel operates the dies by a combination of cams, and this motion will drop a slat, carry it to the dies, compress both ends, and throw it off.

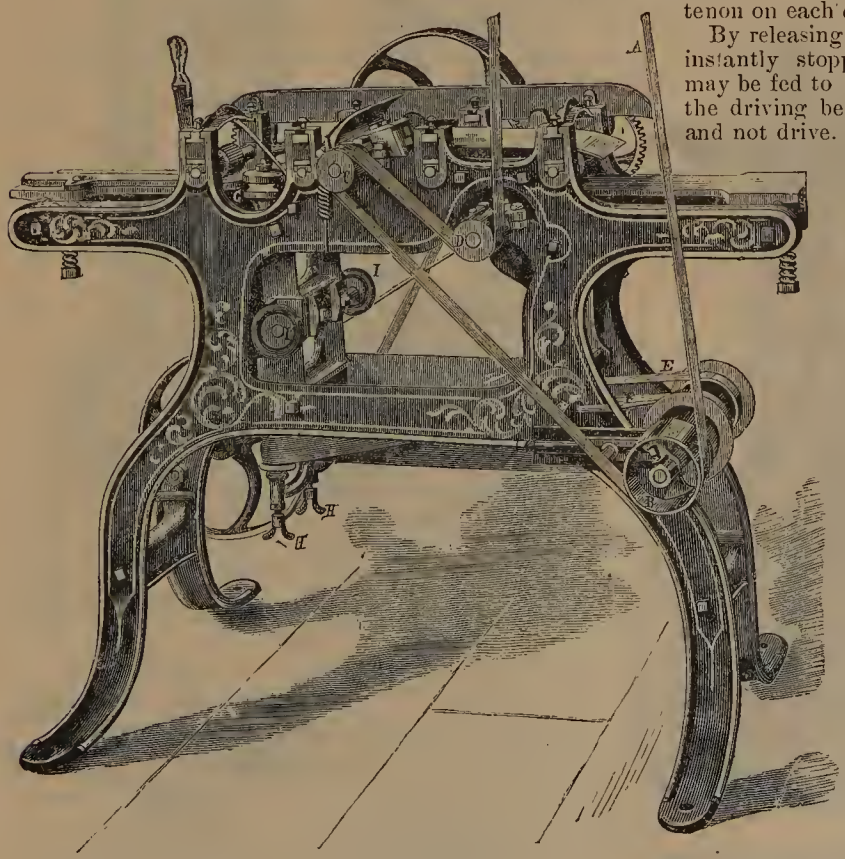
Fig. 328



Blind-slat Crimping Machine.

Blind'-slat Pla'ner. A planing machine for finishing slats for window-blinds, doing the work on both sides, and rounding the edges simultaneously. *I I* are hand-wheels by which the edge-cutters *G* are regulated to any width of slat. The table is regulated by screws underneath. *C D* are the pulleys of the upper and lower cylinders, each of which has four cutters. The machine has four sets of feed-rolls. *F E* are bands from pulley *B*, leading to the edge-cutter arbors.

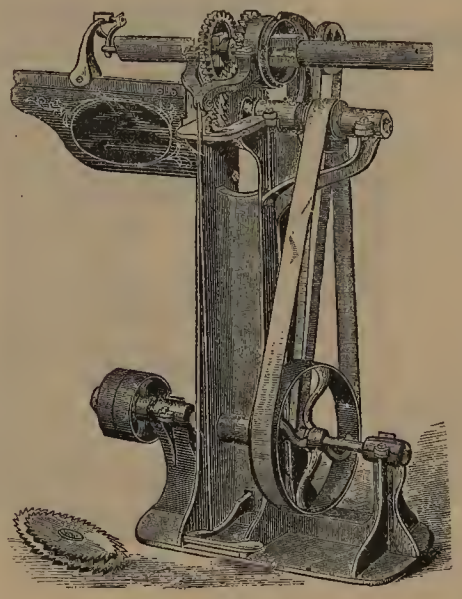
Fig. 329.



Blind-slat Planer.

Blind'-slat Ten'on-ing Ma-chine'. A machine which operates upon long rods which have been dressed to the shape for slats. The slat is fed endwise through rotating chucks, the shoulder being pressed against an adjustable gage for regulating the length of slat. By the peculiar construction of the revolving cutting tools, two tenons are cut and divided with one cutter head simultaneously at one operation. A pressure upon the treadle causes a rotation of the slat and at the same time depresses the chucks carrying the slat against the cutting tools, enabling them to form a perfect tenon on each end.

Fig 330.



Blind-slat Tenoning Machine.

By releasing the treadle the chucks are instantly stopped, in order that the slat may be fed to the gage, at the same time the driving belt is slackened, so as to slip and not drive. It will work any length of slat from $1\frac{3}{4}''$ up to $24''$, and will make any size of tenon desired. See also Blind Machinery on pp. 298–300, "*Mech. Dict.*"

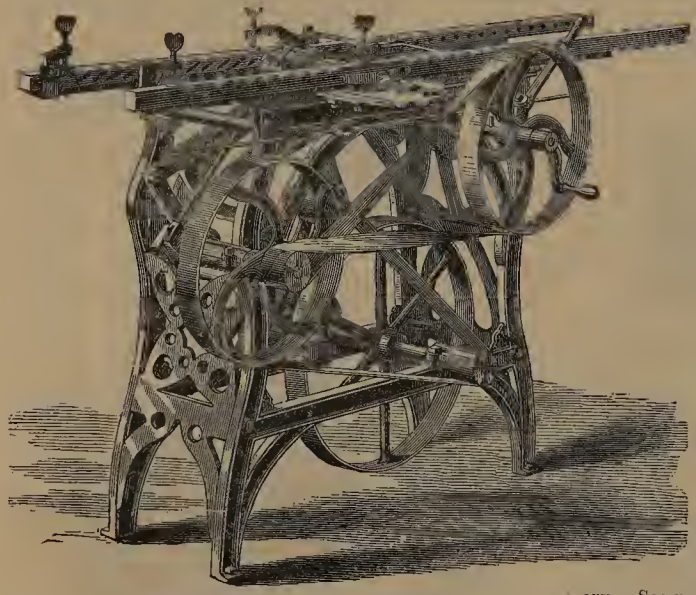
Blind'-stile Bor'er and Mor'tis-er. This machine acts upon two stiles at once, and will make mortises of any length, from a round hole up to $2\frac{1}{2}''$; or it will bore stiles with round holes for rolling blind slats. See Fig. 331.

Blind'-stile Rout'er. A machine for cutting the recesses for blind-rods; in fact, a boring machine for the tenons of slats which occupy each an oblique mortise in the stile. See Fig. 332.

Blind Stitch. (*Harness.*) An ornamental stitch placed upon the outside cover to a blind or strap, the under side of which is covered by the lining. A stitch that is shown on one side only of the leather.

Blind-wir'ing Ma-chine'. This machine (Fig. 333) has guides for conducting the staple to the rod; a device for feeding the staple between the guides, a driver for forcing them into the rod, and

Fig. 331.

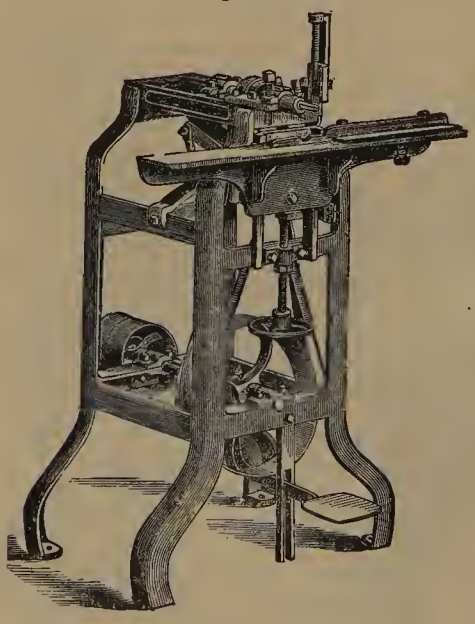


Blind-stile Borer and Mortiser.

a device for moving the rod forward any required distance as each staple is driven.

It is mounted on a substantial iron column and worked by foot, leaving the operator free with both hands to manipulate his work. It will space off, and set and drive at the rate of 80 staples per minute.

Fig. 332.



Blind-stile Router.

Blis'ter Steel. (*Metallurgy.*) Another name for cement steel; made from wrought iron in a cementation furnace. Figs. 1197, 1198, p. 509, "*Mech. Dict.*"

Block. 7. (*Add.*) An engraved wooden stamp, used for printing fabrics before the invention of the roller printer.

Block-printed linen was produced in Flanders in the fourteenth century. See BLOCK-PRINTING, p. 303, "*Mech. Dict.*"

8. (*Arch.*) A plain or enriched projecting division in an entablature.

9. (*Pulleys.*) *Bouche*, the metallic bushing of the cheeks.

Channel, the opening in the shell to hold the sheave.

Cheeks, the sides of the shell.

Coak, the bushing of the sheave.

Gorge, the groove around the sheave.

Pin, or *Pintle*; on which the sheave runs.

Score, the grooves on the body to hold the strap.

Sheave, the grooved-edged wheel for the rope.

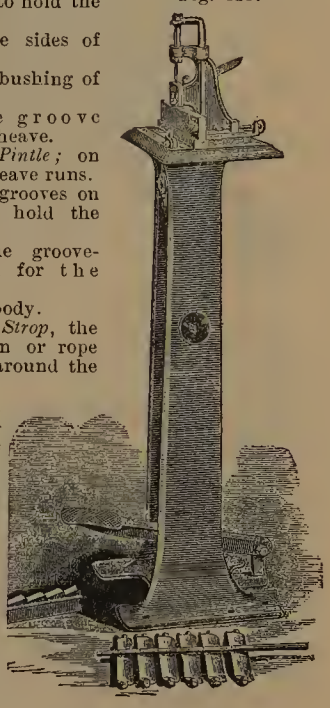
Shell, the body.

Strap, or *Strop*, the band of iron or rope which goes around the block.

Swallow, the space between the sheave and shell in which the rope runs.

Block-making machinery. See p. 303, *"*"*Mech. Dict.*"

Fig. 333.



Blind-wiring Machine.

Blocks and Rope'-lead-ers. See under the following heads:—

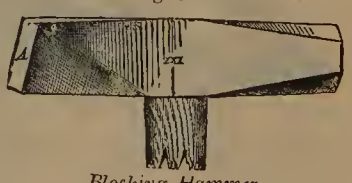
Angle block.
Anti-friction block.
Awning block.
Becket block.
Boom-sheet block.
Bull's eye.
Buntline leader.
Cargo block.
Chain pulley-block.
Clothes-line block.
Davit block.
Dead eye.
Deck block.
Differential block.
Differential pulley block.
Dock block.
Eye block.
Gin block.
Heart.
Hoisting block.
Hook and swivel block.
Horse hay-fork block.
Iron strapped block.
Jib-sheet block.
Lizard.
Loose-hook block.
Man-rope eye.
Match-hook block.
Open-sheave block.
Parrel-truck.
Peak halliard block
Power hoisting-block.
Pulley block.
Roofing block.
Rope eye.
Rope-strapped block.
Sheave.
Sister-hook block.
Snatch block.
Stiff-hook block.
Swing-block.
Swivel-block.
Swivel-hook block.
Tackle block.
Thimble.
Thimble-eye block.
Top-mast truck.
Traveler rope.
Truck.
Well-wheel block.
Wire rope thimble.

Block'er. (*Hat Making.*) A hat blocking machine. See BLOCKING MACHINE.

Block'ing Ham'mer. 1. A steel hammer from one to two pounds weight, used in breaking masses of flint to form blocks from which flakes can be detached by the *flaking* hammer. Called also a *quartering* hammer. — *Evans'* "*Ancient Stone Implements of Great Britain*," 17.

2. A hammer used in straightening saws. The face at *A* is slightly rounded, and its shape, combined with its line of motion, gives it a sort of draw blow, which spreads the

Fig. 334.



Blocking Hammer.

force of the displacement of material iu a given direction, and not merely equally on all sides. — "*Scientific American*," * xxxvi. 259.

Block'ing Ma-chine'. A machine in which the crudc cone-shaped hat-body is brought to shape.

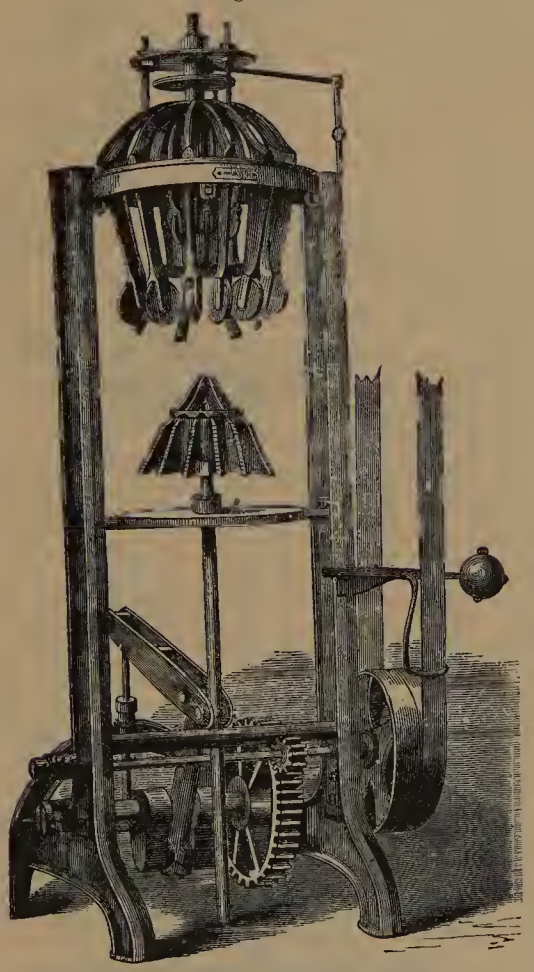
The operation consists iu pulling out the edge to develop the brim, and widening out the upper part to form the tip and the side crown.

It is necessary, in order to stretch the hat, to soften the felt in boiling hot water, and the handling is exceedingly difficult.

The first machine for the purpose was invented by D. Beard, of Guilford, N. C., and patented May 28, 1816. It was a blocker made of a number of pieces hinged at their lower ends to a bench and spread from the center by a treadle, while the hat body was held on the block by the operator. This was the only invention in this part of the hat manufacture until that of W. A. Fenn, of Danbury, Conn., patented April 21, 1857.

In Fenn's machine, two pairs of conical rollers were put into a frame so arranged that the upper pair could be pressed upon the lower ones. The forward pair of these rollers revolved at a slightly faster speed than the other pair, and,

Fig. 335.



Eickemeyer's Hat-stretching Machine.

when the edge of a hat body was clamped between the lower and upper rollers, that part of it which was between the two pairs was drawn out, and the hat body thus gradually stretched around the edge until sufficiently flattened to form the brim. See also his patents, April 14, 1857; January 19, 1858.

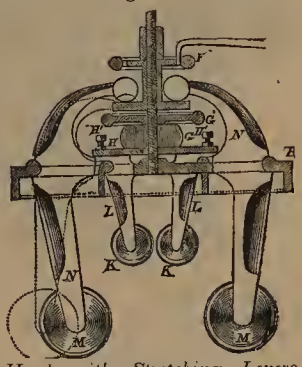
A number of machines of this kind came into use, but, their action being slow and doing but part of the work, the machines did not prove of sufficient advantage to bring them into general use.

The first machine which performed the stretching of a hat body successfully, on wool as well as on fur hats, was the corrugation stretcher invented by R. Eickemeyer, and this machine in its various modifications to suit the different kinds of work is now almost exclusively used in the hat factories of this country.

The machine illustrated in Fig. 335 represents a stretcher now in use in the wool hat factories.

A ribbed and recessed former is mounted upon an upright spindle, which receives motion through a walking-beam and connecting-rod from the crank-shaft. Upon the cast-iron side frames the head of the machine is supported: in this head the stretching devices are suspended. The details are more clear in some respects in the sectional view, Fig. 336.

Fig. 336.



Head with Stretching Levers (Hat-stretching Machine).

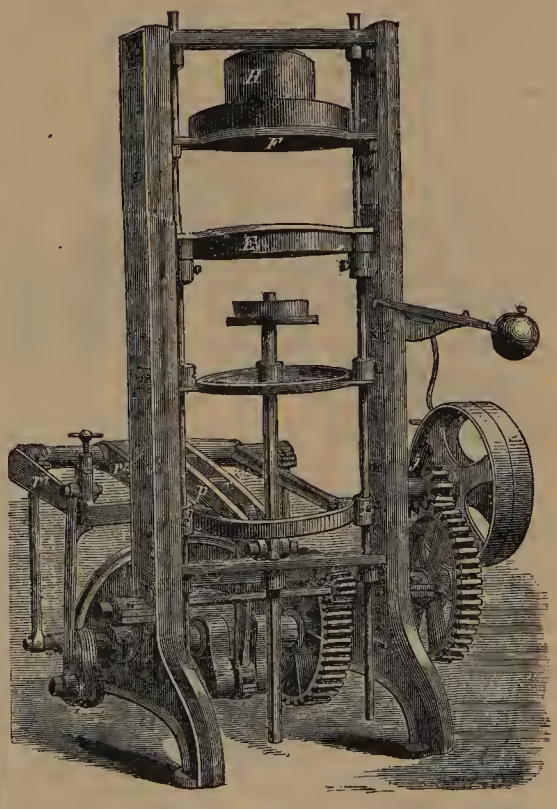
A series of levers, *L*, corresponding in number with the recesses in the upper part of the *former*, *D*, is suspended upon bearings and held in position by a plate, *H*, upon which a rubber spring, *G*, is pressed by a screw-wheel, G^1. In the lower ends of the forked levers smooth rounded rollers have their bearings.

Another series of rollers, *M*, with levers, *N*, and corresponding in number with the ribs in the lower part of the former, is also suspended from this head, and these latter levers are adjustable by a hand-wheel, *F*, nearer to or farther from the center of the machine, as shown in dotted lines on one side of the sectional view.

A hat body properly wetted with hot water, or by steam, is placed upon the *former* while the machine is in motion. The former moving upward brings the hat body in contact with these rollers which enter the recesses between the ribs of the former, and the hat body is thus readily stretched. Five or six upward motions are required to develop the tip and brim fully, the operator shifting the hat body around the center every time the former is at its lowest position, to present other parts of the hat body for contact. The hat having been stretched, it now remains to make what is called in the trade the *band*, namely, the sharp angle formed by the junction of the brim and side-crown.

This operation is performed on the blocking machine, of which Fig. 337 is a perspective view, while in Figs. 338, 339,

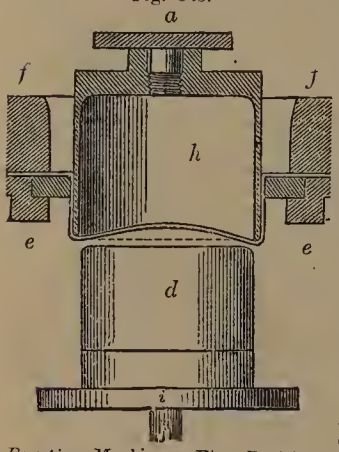
Fig. 337.



Wool-hat-body Blocking Machine.

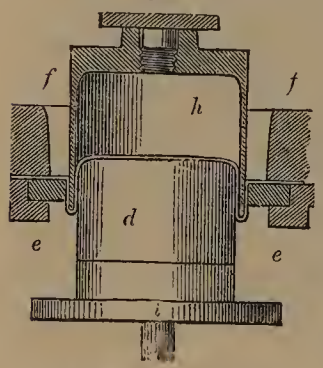
and 340 the action of the machine upon the hat is illustrated. The machine consists of a frame, in which an upright sliding-spindle is centrally mounted. Upon this spindle, which is operated from the crank-shaft by the walking-beam, is the block *d* (Fig. 338, etc.), upon which the hat to be drawn is placed. A supporting plate, *e*, which receives motion through two rods from a lever, r^2, from the adjustable crank on the side of the machine, receives the hat. When the plate *e* is raised, a plate, *f*, which rests upon brackets on the frame, clamps the hat brim, and the two, continuing to move up, draw the hat body over the banding shell *h*. The block-carrier *i*, with the block *d*, has in the mean time also moved up to position shown in Fig. 338.

Fig. 338.



Banding Machine. First Position.

Fig. 339.



Banding Machine. Second Position.

The clamping plates *e f* now commence to descend, while the block *d* continues to move up, and enters the banding shell, drawing the side-crown over the round edge of the shell *h*, as seen in Fig. 339.

These motions continue until the plates *e f* rest upon the flange of the block-carrier *i*, and the hat is drawn perfectly smooth upon the block *d*, as shown in the last of the sectional diagrams, Fig 340.

The spindle now begins to move down, when the clamping-plate *f* is left upon the brackets of the frame, the hat and block are removed, and the operation repeated on the next hat.

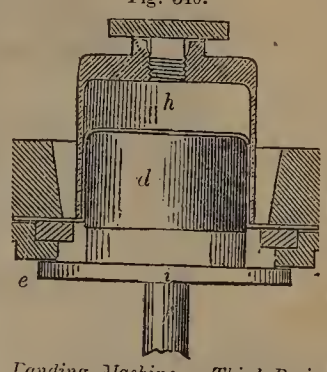
With the use of the stretcher, Fig. 337, and one of the blockers here described, 20 dozen of wool hats can be stretched and blocked per hour by two operators.

To adapt the principle of stretching by corrugation to fur hats, a number of modifications were required. It was found advantageous to separate the *brim-stretcher* from the *tip-stretcher*, and to substitute round-edged bars for the round-edged rollers.

See BRIM-STRETCHER, TIP-STRETCHER.

For the finishing-blocker, see HAT-SHAPING MACHINE.

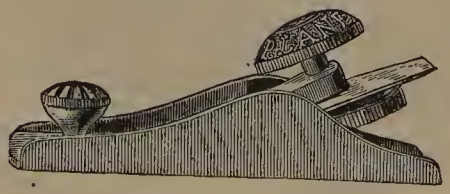
Fig. 340.



Banding Machine. Third Position.

Block Plane. A plane, the bit of which is set at a very acute angle to the working surface, to enable it to plane across the grain of the wood: as distinguished from a *smooth* plane, which see and compare.

Fig 341.



"Victor" Block Plane.

Block Sys'tem. A system used to prevent more than one train from occupying a given space between stations at the same time.

By this system a train is not allowed to leave station *A* until the signal-man at *A* learns from the signal-man at *B* that the preceding train has reached *B*, or that the line is clear between *A* and *B*.

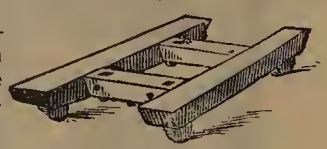
The system is confounded in some cases with the interlocking system of switches and signals; the latter, however, is used only in connection with switches at stations, junctions, etc, and has nothing to do with the movements of trains between stations.

See the following references: —

Block signaling . .	* "*Telegraphic Journal*," iv. 21.
	* "*Telegraphic Journal*," iv. 33, 69.
	"*Telegraphic Journal*," iv. 173, 208.
Automatic	* "*Engineering*," xxi. 428.
	* "*Railroad Gazette*," xxii. 113.
	"*Engineer*," xli. 359.
Needle disk signaling instrument.	
Spagnoletti . . .	* "*Telegraphic Journal*," iv. 34.
Semaphore three-wire signaling instrument.	
Preece	* "*Telegraphic Journal*," iv. 54.
Preece's single wire instrument.	
	* "*Telegraphic Journal*," iv. 82.
Saxby & Farmer .	* "*Railroad Gazette*," xxii. 341.
Tyer & Norman .	* "*Telegraphic Journal*," iv. 129.
Walker's semaphore	* "*Telegraphic Journal*," iv. 115.
Whyte	"*Amer. Railroad Jour.*, xlix. 861.
	"*Van Nostrand's Mag.*," xxii. 457.
	"*Scientific American Sup.*," x. 1.

Block Truck. A small strong four-wheeled truck for single heavy packages.

Fig. 342.



Block Truck.

Blo'm'a-ry. (*Metallurgy.*) 1. A form of furnace for the extraction of malleable iron from ore.

The term may be held to include the various native processes not yet disused entirely in Europe, and practiced from time immemorial in Asia and Africa (see Fig. 5220, p. 2221, "*Mech. Dict.*"). These furnaces are on a small scale, open at top, and are frequently made of clay or earth, with openings below for the tuyeres of the rude bellows used to urge the fire. Iron sand, or rich pulverized ore, are heated with charcoal, and the metal agglutinates into a lump (*loup*), which is hammered to remove dross, and then forms a *bloom*. The heat of the furnace is not sufficient to melt the metal. The Catalan furnace is a notable example (see Catalan Furnace, Fig. 1185, p. 502, "*Mech. Dict.*"); but the same form is found in Silesia and Bohemia, as well as in other iron countries of Europe, as a ready method of working rich ores where wood is abundant, and without much expense for plant.

The description by Diodorus Siculus of the process used in the island of Elba in his time is quite lucid, and his statement that it forms an iron *sponge* brings him in technical accord with the metallurgists of to-day; or us with him, let us say.

In the Catalan furnace the ore is principally deposited upon a sloping wall of the furnace opposite the tuyere, and the rest of the cavity filled with charcoal. The iron sinks to the bottom, and the agglomerated mass is removed at intervals of time.

In the German blomary the furnace is filled up with burning charcoal, and the broken ore is placed on top, being renewed from time to time as it sinks down through the fuel; until enough has gathered at bottom to form a *loup*, which is withdrawn and forged into a *bloom*.

The German blomary has been somewhat extensively introduced into the United States, and the names it is known by, the *Champlain forge*, *Jersey forge*, indicate the places and classes of ores upon which it has been successfully used. The Northern New York blomaries furnish large amounts of metal for the Pittsburg steel makers.

The original forges among rude nations were small pits or clay-walled structures; refractory stone was then used, but iron boxes are now frequent, lined with refractory bricks.

The French Catalan forge is about 40″ × 32″, 24″ deep.
The German blomary forge is about 21″ × 14″, 15″ deep.
The Northern New York, 28″ × 32″, 36″ deep.

The figures vary very much, but these are approximate.

At the Moisic works, on the Lower St. Lawrence, the magnetic iron sands are worked in a German blomary, with a hot blast at 600° Fah., and the slag is withdrawn from above the iron by tapping.

Pig-iron is converted into blooms in 58 blomaries, which are mainly located in Pennsylvania.

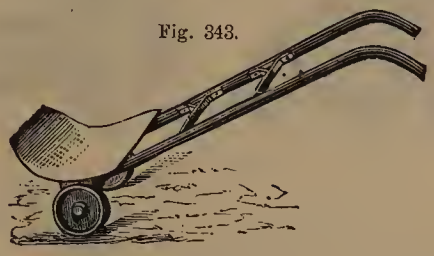
Blooming mill, Springfield, Ill. * "*Engineering*," xxix. 372.

2. A furnace in which pig-iron is purified, and made fit to be forged into a *bloom* of malleable iron. A *puddling* furnace.

Bloom. (*Leather.*) A yellowish deposit upon the grain-side of a hide or skin derived from the bark used in tanning. Its ease of removal depends upon the hardness of the water used by the tanner. The softer the water the more readily can the bloom be removed.

Bloom Truck. A small iron truck on two

Fig. 343.

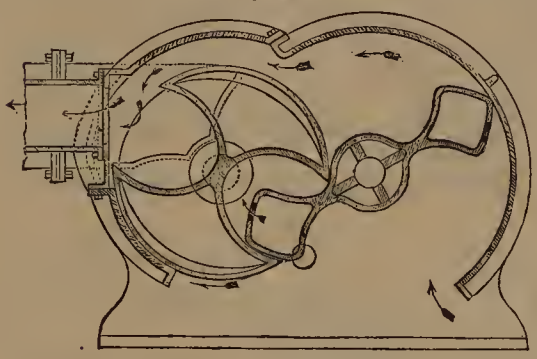


Bloom Truck.

wheels, for carrying blooms or fagots of iron from the furnace to the hammer or squeezer.

Blot'ting Pa'per. Description of the grades, makes, and methods of manufacture of various blot-

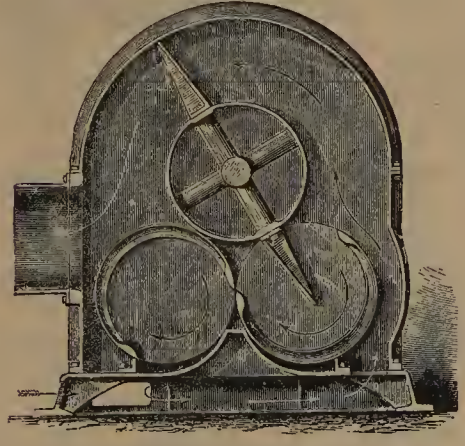
Fig. 344.



Disston's Pressure Blower.

ting papers. — "*Paper Trade Journal*," reproduced in "*Scientific American Supplement*," p. 266.

Fig. 345.



Baker's Pressure Blower.

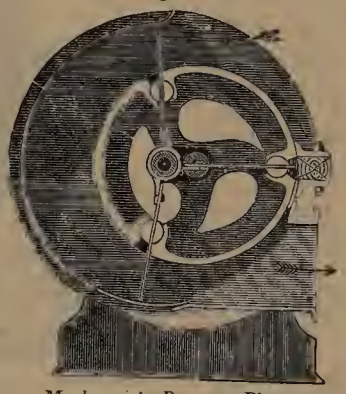
Blow. (*Founding.*) A casting is said to *blow* when, in consequence of the dense nature of the sand or the inadequate *vent* provided by the molder,

Fig. 346.

Root's Pressure Blower.

the gases and steam force their way through the molten metal instead of passing quietly off. This takes place occasionally with great violence and noise, masses of the fluid metal being thrown from the mold.

Fig. 347.



Mackenzie's Pressure Blower. (*Smith, Sayre & Co.*)

Blow'er. 1. Additional to the forms of duplex rotative pistons (shown on p. 1985, "*Mech. Dict.*") acting in concert and forming what are known as pressure blowers, — inasmuch as the air inclosed is absolutely driven, — are some other forms, which do not need specific detailed description, as the sectional views will be readily comprehended.

Fig. 348.

Enfer's Piston Bellows (*French*).

Root's mine ventilator is a form of blower. See "*Scientific American Sup.*," x. 1588.

The terms *blower*, *blowing engine*, *blowing machine*, though perhaps readily distinguishable, are used somewhat indiscriminately. The *blowing engine* is properly a machine having the power within itself, and in this respect the air-compressing machine (which see) is closely allied. They are all forms of air-pumps, and mechanical ventilators are congeners. *Insufflators*, *injectors*, *ejectors*, *atomizers*, *aspirators*, also have many features in common with blowers. *Bellows*, perhaps, are the most common examples of the class.

Emery's Report, "*Centennial Reports*," vol. vi., Group XX., contains notices of —

Sturtevant	* p. 41.
Root	* p. 41.
(Gas exhauster)	* p. 42.
Baker	* p. 42.
Weimer (piston)	* p. 44

Fig. 348 is a French form of blower, the rotative motion of the hand-wheel being converted by crank and pitman into a reciprocating motion of the piston in a cylinder. It is double-acting.

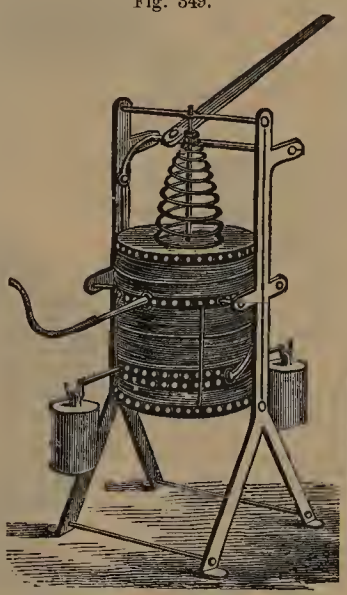
Fig. 349 shows a blowing machine for the laboratory or assay office, to be used in connection with a blast gas-furnace (which see), or similar apparatus.

2. (*Mining.*) A strong discharge of gas from a hole or fissure.

Blow'-gun. A tube with a missile propelled by the breath.

Blow'ing En'gine. The reciprocating piston-blower, driven by beam-engine, is shown in Figs. 3, 4, article "*Machines Sufflantes*," tome ii., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877.

Fig. 349.



French Circular Bellows.

The same article has the trompe, bellows, tympanum, helix, etc.

See under the following references also: —

Blowing engine.

Baker	* "*Eng. & Min. Jour.*," xxii. 282.
Bethlehem, Penn.	* "*Engineering*," xxiv. 199.
Beverley & Atkins, Eng.	* "*Scientific Amer. Sup.*," 2253.
Cambria Iron Co.	* "*Engineering*," xxvi. 233.
Crown Point, N. Y.	* "*Engineering*," xxv. 208.
Disston	* "*Eng. & Min. Jour.*," xxii. 298.
Georgshütte, Ger.	* "*Engineering*," xxvi. 28.
Knowles	* "*Iron Age*," xvii., Feb. 10, p. 1.
Knowles	* "*Eng. & Min. Jour.*," xxii. 247.
Lebanon, Penn.	(See Weimer).
Lonsdale, Br.	* "*Engineering*," xxii. 498.
"Lucy Iron Works"	* "*Engineering*," xxvi. 411.
	* "*Engineering*," xxviii. 161.
Morris, vertical	* "*Engineer*," xlii. 95.
	"*Iron Age*," xvii., April 20, p. 3.
	* "*Engineering*," xxii. 128.
	* "*Scientific American*," xli. 322.
	* "*Scientific American Sup.*," 610.
Pribram, Austria	"*Iron Age*," xvii., May 11, p. 16.
Reading Hyd. Works	* "*Iron Age*," xviii., Oct. 12, p. 1.
Root	* "*Eng. & Min. Jour.*," xxii. 268.
Weimer Works, Penn.	* "*Engineering*," xxii. 294.
	* "*Scientific American Sup.*," 799.
	* "*Iron Age*," xviii., Oct. 9, p. 1.
	* "*Iron Age*," xx., Sept. 30, p. 3.
	* "*Iron Age*," xxv., June 3, p. 1.

Blower.

Boston Blower Co.	* "*Man. & Builder*," x. 1.
"Keystone"	* "*Iron Age*," xviii., Dec. 21, p. 7.
"Cyclops," *Rownson, Drew & Co.*, Br.	* "*Engineering*," xxi. 8.
Steam, for smithy, *Körting*.	* "*Scientific American Sup.*," 616.
Reversible, *Sturtevant*	* "*Manufac. & Builder*," xi. 102.
Root	* "*Scientific American Sup.*," 800.
Forge, *Root*	* "*Iron Age*," xix., June 28, p. 1.
Rotary, *Alaud*	* "*Manuf. & Builder*, ix. 76.

Blower and exhauster.

Brakell, Br.	* "*Engineer*," xlii. 239.
Brakell	* "*Scientific American Sup.*," 839.

Blow-pipe furnace.

Brustlein, Fr.	* "*Iron Age*," xxii., Aug. 15, p. 15.

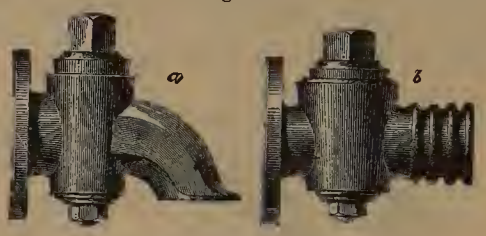
Blow'ing Fur'nace. (*Glass.*) One from which the melted glass is worked, after having been previously fused in a *melting* furnace, and then transferred to the *blowing* furnace; the contents of the melting-pots being transferred in succession. This is the preferable practice when fuel is cheap. In America the glass is usually worked direct from the melting furnace.

Blow'ing Ma-chine'. See BLOWER; BLOWING ENGINE.

Blow'ing Tools. (*Mining.*) A small set of blasting instruments.

Blow'-off Cock. A faucet to allow a part of the contents of a boiler to escape to get rid of mud, sediment, or saturated salt water.

Fig. 350.



Blow-off Cocks.

a. Blow-off bib-cock. *b*. Blow-off hose-cock.

Blow'-pipe. The following references may be consulted: —

Dodge & Gushurst	"*Sc. Amer. Sup.*," 896.
Bellows, *Casamajor*	* "*Sc. Amer. Sup.*," 2081.
Dodge	* "*Sc. Amer.*," xxxv. 374.
Landauer	* "*Sc. Amer.*," xxxiv. 131.
Pocket, *Casamajor*	* "*Sc. Amer. Sup.*," 204.
Rumley	* "*Sc. Amer.*," xxxiv. 115.
And spectroscope	* "*Sc. Amer. Sup.*," 698.
And gas generator, *Thomson*	* "*Sc. Amer. Sup.*," 1510.
Foot power, *Burgess*	* "*Sc. Amer.*," xlii. 99.

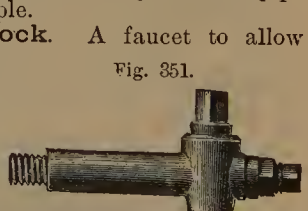
The blow-pipe for glass working is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iii., Article "*Souffler le Verre*." Blow-pipe of combustible vapors. *Ibid.* Fig. 398, tome i., Article "*Chalumeau*."

See, also, *Plattner's* "*Blow-pipe Analysis*;" *Plympton's* "*Blow-pipe Analysis*."

Blow'-pipe Furnace. One in which the air, combustible, and sometimes steam therewith, are blown into a metallurgic furnace for smelting, reducing, or vaporizing metals. *Duryea's* blow-pipe ore-furnace is an example.

Blow'-through Cock. A faucet to allow passage to steam from a cylinder or other chamber in the process of heating the same and expelling the air by blowing steam through it.

Fig. 351.



Blow-through Plug Cock.

Blub'ber Min'cing Ma-chine'. A machine for cutting up whale blubber for trying out.

Patent 3,290	*Soule & Carsley.*
9,478	*Ricketson.*
28,179	*Hunter.*

The blubber knife, blubber hook, and blubber fork are used in preparing and handling the blubber.

Blue Bronze. A blue powder for dusting on a prepared adhesive surface.

Mix powdered mica with a blue pigment, add the mixture to varnish, and lay on with a brush.

See "*Manufacturer & Builder*," vi. 299; viii. 263.

Blue Glass. Glass colored with cobalt, manganese, etc. Has some peculiar effects on vegeta-

tive growth, and the same is claimed to be true in respect of animal growth.

See Gen. A. J. Pleasanton's Patent, September 26, 1871.
"*Scientific American*," xxxvi. 113.
"*Iron Age*," xix., February 22, p. 3.
Mang and Chrome . "*Sc. American Supplement*," 2080.

Blue Pro'cess for Cop'y-ing. A mode of copying tracings in lieu of re-tracing them.

On a board as large as the tracing lay two thicknesses of blanket to give a yielding backing; lay on this the copying paper, sensitized side upward, and upon this the tracing, which is covered by a glass plate to hold all smoothly. Expose in sunlight for from six to ten minutes, or under a sky-light for thirty minutes. Remove the paper, drench it with water, and hang by one corner to dry.

For the sensitizing solution, take in vessel: —
1⅞ oz. citrate of iron and ammonia.
8 oz. clear water.
In another vessel: —
1¼ oz. red prussiate of potassa.
8 oz. water.

Mix solutions, and keep in yellow bottle or away from light. The solution is applied with a sponge, and the paper laid away in the dark. When dry, the paper is yellow or bronze; after exposure, a darker bronze; after washing, the blue tint appears with lines in white.

Blu'ing. A fine blue tint is obtained by boiling iron or steel articles in the following mixture: — Dissolve 4 oz. hyposulphite of soda in 1½ pint of water, and then add a solution of 1 oz. acetate of lead in 1 oz. of water.

Blun'ger. (*Ceramics.*) A revolving bar in which the materials for pottery are incorporated.

The materials, with sufficient water to form a *slip*, are agitated by paddles, on a horizontal axis which revolves in the box. The slip is run off to the *strainer* or *consolidator* (which see).

Blunt Gor'get. (*Surgical.*) A lithotomic instrument for forcing an opening through the prostate gland, in place of cutting.

Fig. 139, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Blunt Hook. (*Surgical.*) One for grasping

Fig. 352.

Obstetric Blunt Hook.

without piercing. Used in various operations. The figures refer to *Tiemann's "Armamentarium Chirurgicum."*

Staphylorraphy hook	Page 10, Part V.
Trachea hook	Page 93, Part II.
Obstetric hook	Page 112, Part III.
Vesico-vaginal hook	Page 68, Part III.

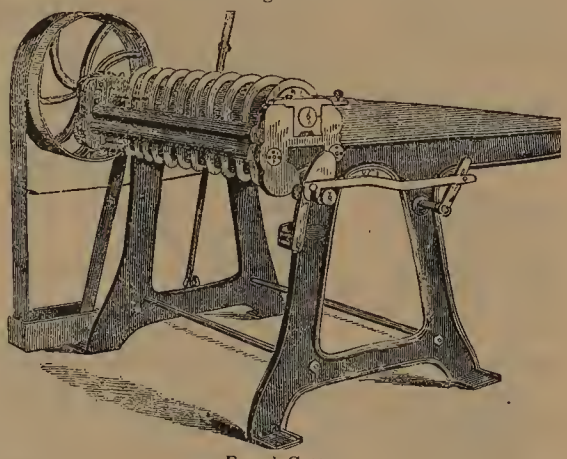
Board Clip. A device for holding paper on a board. Especially intended for telegraph dispatch blanks which are written upon the top blank of a pile and then torn off.

Fig. 353.

Board Clip.

Board Cut'ter. 1. (*Bookbinding.*) A machine with circular shears for cutting binders' board into sizes for use. The frame and bed are made of cast iron, the shears and shaft of cast steel. The board is first cut into long strips, and then, by the adjustment of a latch, the bed carries in the strips for cross-cutting.

Fig. 354.



Board Cutter.

Board Cut'ting Ma-chine'. 2. A machine for cutting thin boards from balks or squared logs.

A powerful machine of this character, invented by Bartlett, has an oblique knife the length of the log, and the boards are shaved off in the manner of a veneer.

"*Scientific American*," * xxxviii. 143.

For the various machines used in Veneer cutting and working, see Figures 6937–6952, pp. 2699–2702, "*Mech. Dict.*"

Board'ing. (*Leather.*) Doubling the leather with the flesh sides together, and driving the fold forward and drawing it backward by the graining-board. It makes the leather supple and raises the grain.

Board'ing Knife. (*Whaling.*) For cutting the *blanket piece* of blubber; the long piece which is flensed or peeled from the sides of the whale.

Board Scale. A weighing balance for assorting, and for ascertaining the number of sheets of pasteboard to make up bundles of 50 pounds.

Board Sea'son-ing Ma-chine'. A machine in which boards are subjected to heat and pressure in order to dry them straight. A large machine of this character has large, flat, steam-heated boxes, which are in vertical series, and pressed together by hydraulic power.

Pfeffer . . * "*Scientific American*," xxxvii. 143.

Boat. For boats, parts, fittings, etc., see

Back board.	Mast hinge.
Boat lowering apparatus.	Nautilus.
Bottom board.	Oar.
Canoe.	Painter.
Cat boat.	Poppets.
Cat rig.	Portable boat.
Center board.	Portable raft.
Clamp (for mast).	Rowing gear.
Collapsible boat.	Rowlock.
Davit.	Rudder lanyard.
Ducking boat.	Skiff.
Folding boat.	Slings.
Grapnel.	Sneak box.
Gunwale.	Steadying line.
Head sheet.	Step.
Ice boat.	Stern benches.
Kyak.	Stern sheets.
Launch.	Stretcher.
Launch engine.	Surf boat.
Lazy painter.	Thwarts.
Life boat.	Well sneak.
Life raft.	Yawl.

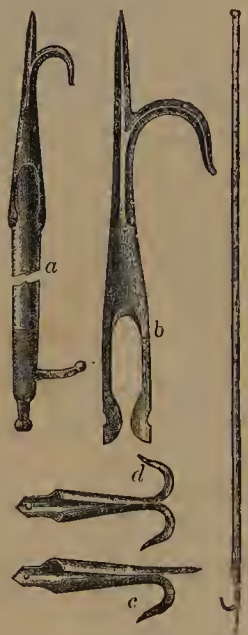
See, also: —

Building	* "*Scientific American Sup.*," 1066.
Cheap	* "*Scientific American Sup.*," 1088.
Collapsing, *Berthon*, Br.	* "*Engineer*," xlviii. 162.
	"*Van Nostrand's Mag.*," xix. 94
	* "*Engineer*," xlviii. 162.
Folding, *Osgood*	* "*Scientific American*," xl. 38.
Berthon	* "*Scientific American Sup.*," 1327.
Duplex, *Berthon*	* "*Engineer*," xlix. 438.
Collapsible, *Crispin*	* "*Scientific Amer.*," xxxviii. 343.
Folding	"*Iron Age*," xx., July 19, p. 1.
Murray & Baker	* "*Scientific American*," xliii. 98.
Ancient Lacustrine	* "*Scientific American*," xxxix. 41.
Lowering apparatus.	
Brice	* "*Scientific American*," xxxv. 150.
	* "*Scientific American*," xli. 412.
Donovan, Br.	* "*Engineer*," l. 401.
Lawrence, Br.	* "*Engineer*," xliv. 430.
Lawrence	"*Engineer*," l. 281
Hydraulic, *Pinker*	* "*Engineer*," xlii. 165.
Model, "Sharpie"	* "*Scientific American Sup.*," 2817.
Non-heeling	* "*Engineer*," xlii. 357.
Propeller, *Fetherston*	* "*Scientific Amer.*," xxxviii. 166.
Rigs	* "*Scientific American Sup.*," 2586.
	* "*Scientific American Sup.*," 2085.
Sectional, *Berthon*	* "*Scientific American Sup.*," 3823.

The "Nautilus" crossed the ocean in 1878 in 45 days. She was 19′ long, 6′ beam, 2′ 3″ depth, and drew 6½″ water. "*Scientific American Supplement*," *2300.

Boat Hook. One used in navigating a boat among other craft, or at a landing.

Fig. 355.



Boat Hooks.

a has an indicator on the staff which shows how the hook stands when in the water out of sight.

b c are two modes of making the hook of usual form.

d is a double hook.

Boat Knot. (*Nautical.*) A hitch, shown at 23, 26, Fig. 2777, p. 1240, "*Mech. Dict.*"

Boat Low'er-ing Ap'pa-ra'tus. Davit apparatus for launching a boat from on ship-board.

The apparatus for detaching boats from their davits, invented by *Albert Magnus*, of Gothenburg, is shown in "*Scientific American Supplement*," *2513.

The apparatus of *E. G. Lawrence*, of Dundee, Britain. *Ibid.*, *1728.

See, also, *Shaw's* apparatus, patented April 1, 1873, and Figs. 745–749, pp. 313, 314, "*Mech. Dict.*," and p. 678, *Ibid.* Also DAVIT, *infra*.

Boat Plug. Removed to allow rain-water to pass out of the boat which is secured on deck. The plug is

Fig. 356.

Boat Plug.

replaced before swinging the boat by the davits to launch it overboard. The two flanges have holes for securing the socket to the outer and inner skin of the boat. Many a boat's-load has been swamped by the loss of the boat plug in the hurry of launching.

Boat'swain's Tog'gle. A pin of wood, crosswise, at the end of a rope; acting instead of a hook when the object to be attached has a loop or bight through which the toggle may be rove.

Boat Yoke. A tiller secured on top of the rudder, and having holes for attaching the steering ropes. See Fig. 357.

Bob'bin Wind'er. A machine for winding conical bobbins. The yarn guide is on a carrier

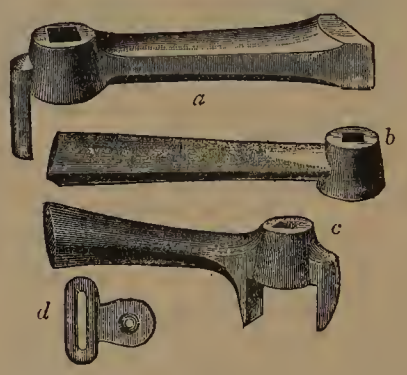
Fig. 357.

Steering Yoke.

which has a certain range of vertical motion to build up the shape; when the set size is reached a cone on the sleeve which carries the guide is brought into contact with the cap, and raises the guide so as to bring its excursions to a higher level. *Dornan Bros.* See, also, KNITTING MACHINE.

Body Loop. The iron which secures the body of the vehicle to the running gears.

Fig. 358.



Body Loops.

a. Single-lip body loop.
b. Ordinary body loop.
c. Double-lip body loop.
d. Strap loop.

Bo'gie. 1. A wheeled swiveling truck beneath a locomotive.

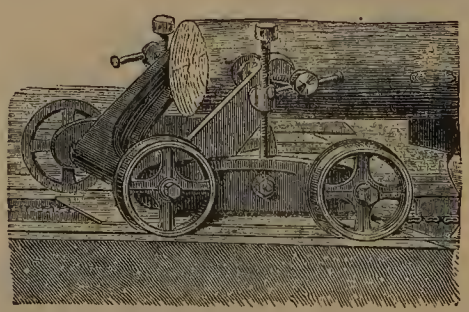
The terms
Double bogie locomotive (two pair wheels),
Single bogie locomotive (one pair wheels),
Leading bogie locomotive (bogie in front),
Bogie tank locomotive (bogie under tank or tender),
indicate the character of the position of the swiveling truck

See

Bogie and axle boxes, oscillating.	
Haswell, Austria	* "*Engineer*," xli. 13.
Car truck.	
Gt. Western Railway, Br.	* "*Engineer*," xlii. 432.
Tank locomotive, N. E. Railway	* "*Engineer*," xlii. 46.
Truck, Japanese	* "*Engineering*," xxix. 143.

2. (*Saw Mill.*) A small carriage running on a transverse track on a log carriage, to shift the po-

Fig. 359.



Log Bogie.

sition of a log relatively to the saw in cutting on a line not coincident with that of the main track. See SAW MILL.

Bo-he'mi-an Glass. (*Glass.*) Consists of a silicate with potash and lime base; a small quantity of alumina, from the pots, and of oxide of iron impurity from the materials. Potash is often replaced for common ware by soda, owing to the lower cost of the latter. Carbonate of potash, as pure and as rich as possible, is preferred, free from soda. It is chiefly extracted from wood ashes, but in Austria the refuse of the beet manufacture yields a good deal. Also known as *Lime glass.*

Boil'er. See the following references to boilers, setting, attachments, etc.: —

Air and steam injector.
Matthews . . . . . * "*Scientific American*," xl. 227.
Casing and setting, *Reilly* * "*Scientific Amer. Sup.*," 682.
Cleaner, *Cronin* . . . . * "*Scientific Amer.*," xxxvi. 130.
Hotchkiss . . . * "*Manufac. & Builder*," xii. 247.
* "*Scientific Amer.*," xliii. 291.
Kemp . . . . * "*Mining & Sc. Press*," xxxiv. 1.
* "*Scientific American*," 351.
Clothing . . . . . "*Scientific Amer. Sup.*," 266.
Corrugator. See FLUE CORRUGATOR.
Covering, *Ashcroft* . . . * "*Scientific Amer.*," xxxiv. 163.
Beamish . . . "*Scientific Amer. Sup.*," 292.
Burgess . . . * "*Scientific Amer.*," xlii. 182.
Drilling and turning machine.
Butterfield, Br. . . . * "*Engineering*," xxix. 398.
Drilling machine.
Garvie, Br. . . . . * "*Engineering*," xxx. 167.
Harvey . . . . . * "*Engineering*," xxviii 136.
Tweddell, Br. . . . . * "*Engineering*," xxvii. 340.
Bowker . . . . . * "*Scientific Amer. Sup.*," 4105.
Bowker, Br. . . . . * "*Engineer*," 1. 307.
Kendall & Gent, Br. . * "*Engineering*," xxix. 434.
* "*Scientific Amer. Sup.*," 1047.
Economizer, *Reilly*, Br. . * "*Engineering*," xxii. 18.
Explosions in 1877 . . . * "*Iron Age*," xxii., Nov. 28, p. 15.
Feeder, self-acting.
Cohnfeld . . . . . * "*Scientific Amer. Sup.*," 2209.
Feeder, automatic.
Fromentin . . . . . * "*Scientific Amer. Sup.*," 3880.
Feed regulator, *Pope*, Br. * "*Scientific Amer. Sup.*," 2050.
Feeder, *Rice* . . . . . * "*Scientific Amer.*," xxxviii. 6.
Flue corrugator, *Fox* . . * "*Engineer*," xlv. 213.
* "*Scientific Amer.*," xxxviii. 67.
Flue tester, Br. . . . * "*Engineering*," xxv. 260.
Fountain, *Hamper* . . . * "*Engineer*," xlii. 32.
Pontifex, Br. . * "*Scientific Amer. Sup.*," 606.
Furnace, hot blast, *Pike* . * "*Scientific Amer.*," xlii. 323.
High pressure.
Adamson, Br. . . . . "*Scientific Amer. Sup.*" 917.
Indicator.
Lethuillier & Pinel, Fr. "*Scientific Amer. Sup.*," 2751.
Making machines, Centennial.
"*Iron Age*," xviii., Aug. 3, p. 5.
Setting, *Reilly*, Br. . . . * "*Engineering*," xxii. 18.
Shell tester, *Tangye*, Br. . * "*Engineer*," xli. 10.
Smith, *Campbell & Hunter* * "*Engineer*," 1. 229.
Stays, machinery for fixing.
Allan, Br. . . . . "*Engineer*," 1. 193.
Tester, *Howard* . . . . * "*Scientific Amer.*," xxxiv. 246.
Tube cleaner, *Titcomb* . . * "*Scientific Amer.*," xlii. 294.
Washer, *Hayes* . . . . * "*Railroad Gazette*," xxxiii. 364.

Boil'er Clamp. A form of clamp for holding parts in apposition while being drilled or riveted. That shown opens 4″ in the jaw and runs back 4½″.

Fig. 330.

Le Count's Boiler Clamp.

Boil'er Cov'er-ing. The Chalmers-Spence covering has a dead air chamber of one inch or more between the covering and the surface covered.

This is secured by taking a wire cloth to which is fastened every 4″ or 6″ a stud of an inch or more in length which keep the wire that distance from the surface of the object covered. A non-conducting composition is plastered over the wire. Patents, 80,709, Aug. 4, 1868; 96,738, Nov. 9, 1869.

Asbestos fiber in sheets, or mixed with some cement, is used with advantage.

Sawdust mixed with flour paste. — "*Textile Manufacturer.*"

See also references under BOILER, *supra*

Boil'er Feed'er. Cook's automatic boiler-feeder is operated primarily by the uncovering of the open lower end of a vertical pipe which projects downward into the boiler. The water sinking below the open end of the pipe allows steam to pass upward and operate the devices which supply water until the level rising closes the pipe opening.

The boiler feeders of Pratt & Whitney, of Hartford, Conn., and Macabie's *Alimentateur Automoteur*, made by Voruz, of Nantes, France, act by means of a head of water and a float in a chamber governing the valved steam passages.

See also: —
Self-acting, *Cohnfeld* . * "*Scientific American Sup.*," 2209.
Automatic, *Fromentin* * "*Scientific American Sup.*," 3880.
Regulator, *Pope*, Engl. * "*Scientific American Sup.*," 2050.
Rice . . * "*Scientific American*," xxxviii. 6.
See also FEED-WATER HEATER, etc.

Boil'er Fer'rule. A tubular bushing for a hole in a domestic heating boiler, affording means of attachment for a pipe of supply or discharge.

Fig. 361.

Boiler Ferrule.

Boil'er Fit'tings. Those portions or attachments which are additional to the mere shell. The term includes the following, but they may not all be present in every boiler: —

Bearers.	High water indicator.
Blow-off cock.	Injector.
Damper.	Low water indicator.
Dead plate.	Man-hole cover.
Economizer.	Mud-hole cover.
Feed valve.	Safety valve.
Feed-water apparatus.	Steam-pressure gage.
Furnace front.	Stop valve.
Fusible plugs in tubes.	Tube plate.
Gage cocks.	Ventilator.
Grate bars.	Water gage.

Boil'er In'di-ca'tor. The electric boiler indicator of *Lethuillier & Pinel*, of Rouen, shown in Paris in 1878, consists of a float and stem, the latter making electric connections at various heights, which are communicated by wire to an indicator-tablet, like an annunciator, fixed anywhere, say in an office, or at the rooms of the boiler inspector.

"*Scientific American Supplement*," * 2751.

Boil'er Patch Bolt. A peculiar form of bolt for securing a patch to a boiler. It is threaded into the boiler, the chamfer rests against the patch and the square is for the application of the wrench.

Fig. 362.

Boiler Patch Bolt.

Boil'er-plate Clip'per. A shears specially arranged for sheet-iron. In that of Fisher, the plate lies upon a table traversing a track, and the shears work at such an angle as to give the proper calking bevel to the edge of the sheet. The tail of the lever which works the movable shear is worked by a cam.

Boil'er Shell Dril'ling Ma-chine'. A machine for drilling rivet holes in boilers. An approved form drills on both sides of a boiler vertically suspended above the standing headstocks. The shell is rotated for presentation to the piercing and countersinking drills.

Kendall & Gent, Br. * "*Iron*."
* "*Scientific American Sup.*," * 1047.
* "*Engineering*," xxix. 434.
Bowker, Br. . * "*Engineer*," 1. 307.
* "*Scientific American Sup.*," 4105.
Tweddell, Br. . . . * "*Engineering*," xxvii. 340.
Harvey, Br. . . . * "*Engineering*," xxviii. 136.
Garvie, Br. . . . * "*Engineering*," xxx. 167.
Butterfield, Br. . . * "*Engineering*," xxix. 398.

Boil'er Smith. A machine for flanging boiler plates.

Campbell & Hunter, "*Engineer*," * l. 229.

Boil'er Test'er. A machine for proving boilers. See

Flue testing, Br. . . . . * "*Engineering*," xxv. 260.
Shell testing, *Tangye*, Br. . . * "*Engineer*," xli. 115.
Testing machine, *Howard* . . * "*Sc. Amer.*," xxxiv. 246.
See also p. 320, Fig. 763, "*Mech. Dict.*"

Boil'er Wash'ing Ap'pa-ra'tus. The system of washing locomotive boilers of S. J. Hayes, Superintendent of Motive Power, of the Illinois Central Railroad, is shown and described in "*Railroad Gazette*," * xxiii. 364.

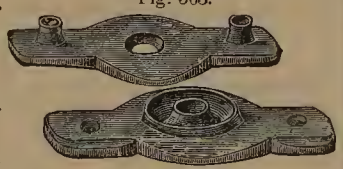
A 2½" pipe hung from the roof trusses of the round-house is carried completely around it in a line directly over the back dunes of the engines as they stand in the pits, and provided with a stop valve at each pit. A steam pump supplies water under heavy pressure. Each engine has a crown washpipe and an attachment for washing the cylindrical part of the boiler. The operation is performed after every round trip.

Bo-la'ta Gum. A substitute for gutta-percha. It is the milky sap of the bully tree on the banks of the Orinoco and Amazon rivers in South America. The operation of winning the gum is similar in every respect to that employed with caoutchouc and gutta-percha. It much resembles gutta-percha, but has, however, some superior qualities. It is tasteless, has an agreeable odor on being warmed, can be cut like gutta-percha, is tough and leathery, is more elastic than gutta-percha, and consequently more flexible. It becomes soft, and may be joined together at about 120° F., but requires 270° F. before melting, higher than gutta-percha. It is completely soluble in benzole and carbon bi-sulphide in the cold. It becomes strongly electrified by friction, and is a better non-conductor of heat and electricity than gutta-percha.

Also known as *balata*.

Bol'ster-plate. A plate in a wagon where the front bolster turns on the axle or the sand board.

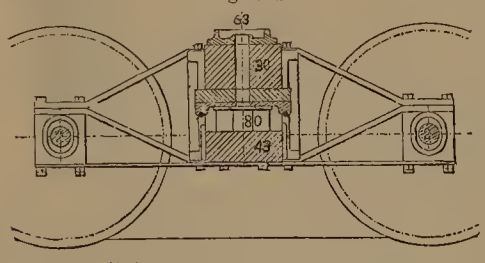
Fig. 363.



Bolster Plate.

Bol'ster Spring. 1. (*Railway.*) One (80, Fig. 364) interposed between the transverse beam (43) of a truck and the truck-bolster (30) which receives the weight of the car on the center plat (63).

Fig. 364.



Railway Truck Bolster Spring.

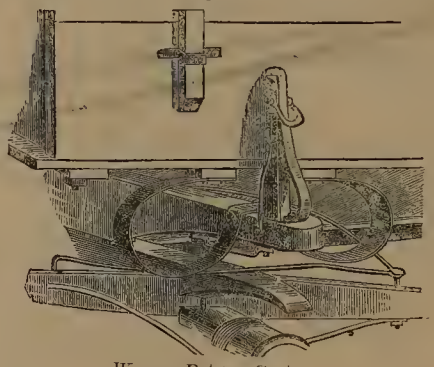
2. (*Wagons.*) *a.* A caoutchouc spring between the bolster and axle to give a degree of elasticity to the bed.

b. Fig. 365 shows a steel spring interposed between the wagon-bed and its bolster to absorb the jar and make the riding more easy.

"*Iron Age*," * xxii., Dec. 5, p. 9.

Bolt. (*Fire Arm.*) 1. The sliding piece in a needle-gun which drives home the cartridge, and carries in its axial recess the firing pin.

Fig. 365.



Wagon Bolster Spring.

2. The part which in a snap-gun passes into the *lump* of the barrel, to hold the barrel into the action when the gun is closed.

3. (*Mining.*) A passage leading from the gate road into a side of work.

For machinery and hardware bolts see, —

Acorn-head bolt.
Bevel-head bolt.
Bridge bolt.
Boiler patch bolt.
Button-head bolt.
Carriage bolt.
Clip king bolt.
Cone-head bolt
Countersunk - head square shank bolt.
Cultivator point bolt.
Elevator bolt.
Elliptic-bead bolt.
Eye bolt.
Felly-joint bolt.
Flour bolt.
Flush bolt.
Guard bolt.
Hanger bolt.
Key bolt.
Key-head bolt.
King bolt.
Knob screw.
Lag bolt.
Loop bolt.
Machine bolt.
Plow bolt.
Railway-truck bolt.
Ring bolt.
Round countersunk bolt.
Round countersunk square head bolt.
Safety bolt.
Shackle bolt.
Shaft bolt.
Ship ring-bolt.
Shoe bolt.
Sink bolt.
Sleigh-shoe bolt.
Square countersunk bolt.
Square head bolt.
Square shank bolt.
Steeple head bolt.
Step bolt.
Stove bolt.
Tap bolt.
Tire bolt.
Track bolt.
U-bolt.
Whiffletree bolt.

Bolt Clean'er. A machine or attachment for cleansing the bolting cloth of mills of the adhering flour and offal.

Collins's automatic cloth cleaner is applied, not to bolts precisely, but to the sieves of middlings purifiers. It has beaters of soft leather arranged in spiral form on a shaft beneath the sieve-cloth, so as when revolving to slap the cloth lightly.

"*American Miller*," * viii. 369.

The Cogswell & Finn flour-bolt cleaner has a brush suspended over the reel by arms secured to a shaft which projects through the side of the chest, so that the brush can be lifted and dropped as desired. A coil spring prevents the brush jumping when passing over the ribs of the reel.

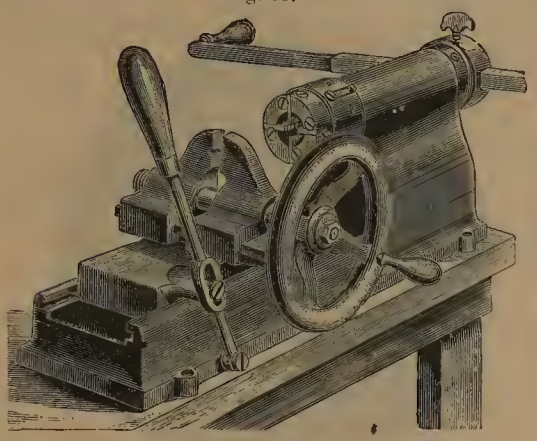
Bolt Clip'per. A double lever tool for cutting off the superfluous length of bolt beyond the nut. The nut *E* lies in a square of the jaw *D*, and the bevel edge of the jaw *C* is brought against the bolt. The tool is of cast steel except the handles, *A*, *B*, and the catches in the arm *F* give different ranges of leverage.

Fig. 366.

Bolt Clipper.

Bolt Cut'ter. A machine for threading bolts. Fig. 367 is Pratt & Whitney's hand bolt-cutter.

Fig. 367

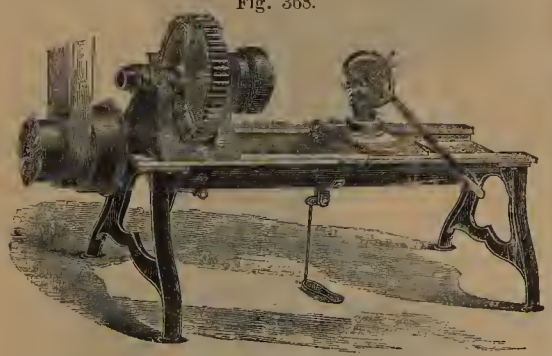


Hand Bolt-cutter.

The bolt is held in the vise, which has a right and left-hand screw, and is tightened by the hand-wheel. The die is revolved to cut the thread, and the bolt is advanced by the lever, which moves the vise slide in the shears. The machine is placed on a bench, and is intended for carriage and jobbing shops. The crank is lengthened or shortened at will; for tapping, the collet on the spindle is replaced by a tap-chuck, and the nuts are held in the vise.

Schlenker's stationary die bolt-cutter is shown in Fig. 368. The bolt is held and revolved in the

Fig. 368.



Stationary Die Bolt-cutter.

head chuck, which is hollow, so that a rod can be advanced axially to have a thread cut on its end. The arrangement of the dies is such that as soon as they begin to cut they will close as far as the stop will allow them, and a series of bolts may thus be cut of the same size. As soon as the bolt is cut the required length, the dies are opened by the lever and the bolt taken out without running the die off the thread. The action of the dies is similar to that of a lathe tool.

The "National" double head bolt-cutter is an open-die machine in which the bolt-cutter head is advanced to the bolt, the latter being held and rotated in the hollow lathe-head and chuck. The bolt is instantly released when threaded; the die blocks contain chasers made on the interchangeable system.

See the following references: —
Revolving die.

Howard Iron Works * "*Am. Manuf.*," June 11, 1880, p. 8.
"National" . . . * "*Scientific American*," xxxix. 404.
* "*Am. Manuf.*," Jan. 3, 1879, p. 13.
Pratt & Whitney . . * "*Scientific American*," xxxiv. 115.
* "*Scientific American Sup.*," 594.
Pratt & Whitney . . * "*Engineer*," xlii. 42.
* "*Am. Manuf.*," Oct. 31, 1879, p. 12.
Nut tapper, *Schlenker.* * "*Iron Age.*" xvii., Jan. 29, p. 1.
* "*Iron Age*," xxii., Nov. 7, p. 1.
Wiley & Russell . * "*Scientific American*," xxxviii. 54.
* "*Iron Age*," xxi., April 11, p. 3.
Wood & Light . . . * "*Manufacturer & Builder*," xi. 5
Trimmer, *Butler* . . * "*Scientific American*," xli. 310.
Table of preparations of nuts and.
"*Scientific American*," xxxv. 53.

Bolt-cut'ter Chuck. A chuck for holding a bolt to be cut in a turret-head machine. In these machines the bolt is held in a chuck and advanced alternately to one or other of the dies in the turret head.

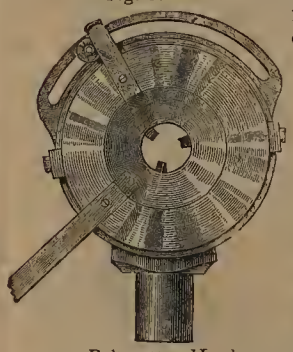
See Fig 6824, p. 2665, "*Mech. Dict.*"

Fig. 369.

Bolt-cutter Chuck.

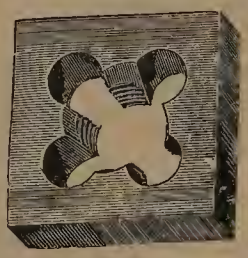
Bolt-cut'ter Head. Fig. 370 shows the die of the Schlenker bolt cutter. It is stationary, the bolt being revolved and advanced to the cutter, see Fig. 368. The chasers are simultaneously advanced or receded in the head by means of a lever which has an adjustable stop, so as to limit their penetration in making a number of bolts of similar size.

Fig. 370.



Bolt-cutter Head

Fig. 371.



Bolt Die.

Bolt Die. A nut with a thread chased in it, used for cutting threads on bolts and rods. Fig. 371.

Bolt Dog. Used in chucking bolts to be turned or chased. It is bolted to the face plate, spans the center, and has a square to engage the bolt head. Made in sizes from $\frac{5}{16}''$ to 2′ inclusive. Fig. 372.

Fig. 372.

Bolt Feed'er. An apparatus to feed the meal to the flour bolt in equable quantities. *D*, Fig. 373, is the case, *E* the spout leading to the bolt, and *B* the lever for lifting the screw *A*.

Bolt Dog (Le Count's).

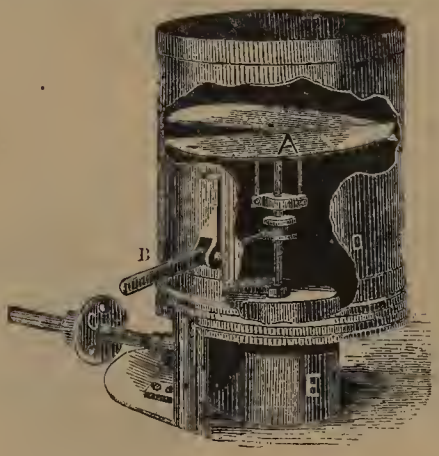
Bolt For'ging Ma-chine'. A machine for forging iron bolts.

Burdict's bolt-forging machine is operated without clutch gear, cam, or springs, the main shaft, slide, and forging dies are in constant motion, and the blank is advanced to the dies by means of a connecting-rod, pawl, shaft, and toggle, and the blank is automatically discharged when headed. The blank rests against a stop, and is only guided centrally by the holding dies while being forged, thus leaving them full size under the head. The machine is capable of making from 3,000 to 8,000 square head blank bolts in 10 hours, according to size.

The Abbe bolt forging machine is a machine of similar capacity and quality.

Bolt-head'ing Ma-chine'. Another name for the bolt-forging machine, which see. The British machine of *Greenwood & Batley*, Leeds, is vertical in its action.

Fig. 373

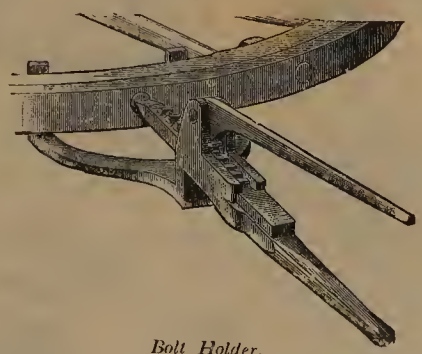


Bolt Feeder.

A vertical fast-moving screw, with three square threads, raises the work-holder to the die, the latter being stationary. The hot bolt-head is thus brought into the die, and swaged to form. The bolt-holder has a dwell at its upper position, and, as it descends, a pin beneath hushes out the bolt.

Bolt Hold'er. A clamping tool to hold the head of a bolt to prevent its turning while the nut is being screwed on. It is a frame containing a sliding bar, having on one of its sides a rack which is engaged by a sector lever. It is shown as applied to put on a tire bolt.

Fig. 374.



Bolt Holder.

Bolt Hook. (*Manége.*) A check-rein hook; the base or point by which it is attached sets flat upon or passes between or under the plates of the saddle-tree, and is secured by a bolt.

Bolt'ing-cloth Clean'er. See Bolt Cleaner.

Bolt'ing Mill'stone. A French invention by M. Aubin.

The lower millstone has panes with screening cloth of wire gauze, to allow the meal to escape before reaching the skirt.

The device is shown at Fig. 375. Starting from the bosom of the stone, every other furrow is suppressed, and a metallic box inserted containing the wire gauze. A knocker is suspended in the box to hasten the sifting.

Aubin's. Safford's Report "*Centennial Exhibition Reports*," * Group I., vol. iii., p. 189.

Bolt'ing Saw. A machine in which stuff is sawed out of the log or balk to *bolts* or pieces of a size, adapted for working into the object required.

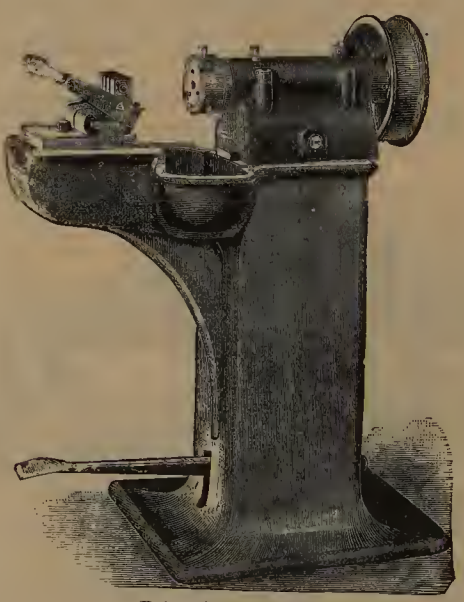
Bolt-point'ing Ma-chine'. A machine for pointing or shaping the ends of bolts of from $\frac{1}{4}''$ to $1''$ diameter.

Fig. 375.

Bolting Millstone.

The bolt to be pointed is held in the vise, which is adjustable on the column of the machine and is operated by a lever and right- and left-hand screw.

Fig. 376.



Bolt-pointing Machine.

The head, arranged to slide on the column, is brought to the bolt by action of the foot-lever, the bolt passing through a bushing to steady it while the revolving cutter is doing its work. Bolts too short to reach from the vise to the cutter in the head may be held in a socket.

Bolt-turn'ing Lathe. A lathe specifically adapted for cutting large bolts; smaller machines, on the lathe principle, are bolt-cutters.

Bom-bar'don. (*Music.*) A low wind instrument without keys, and with three cylinders. The quality differs but little from the ophicleide.

Bomb Har-poon'. A harpoon with an explosive, to be ignited inside the whale. See list of U. S. Patents under Harpoon.

Bomb Lance. A lance containing a bomb to be exploded in the whale. It is generally, but not always, projected from a gun.

See list of United States Patents under Harpoon

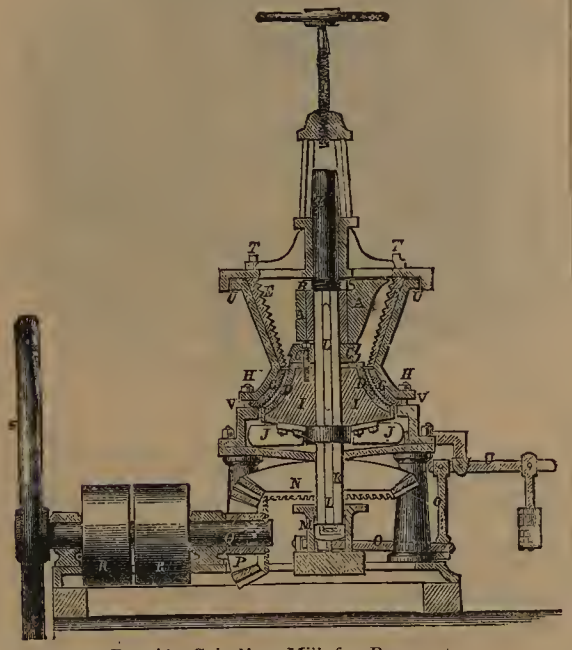
Bomb lance, *Pierce.* * "*Scientific American*," xliii. 403.

Bone Black. Calcined bones, used in filters for sirups, etc.

See : —
Testing, *Bartlett*. . . . . "*Scientific Amer.*," xxxiv. 260.
Washer, Automatic . . . * "*Scientific Am. Sup.*," * 4052.
Revivifier, Fr., *Schreiber* . "*Dept. Agric., Special Report*," xxviii., Pl. XXXI.

See also ANIMAL CHARCOAL, *supra*.

Fig. 377.



Baugh's Grinding Mill for Bones, etc.

A is the top breaker fitting on the vertical mill-shaft *K*. The breaker is varied with the kind of work to be performed.
B is the nut which secures the breaker.
C, circular grinder or middle breaker with holes for stud bolts, to tighten the grinding sections *DD* on cone *I*.
F, stationary grinding plates. *G*, lower cylinder sectional plates, held by nuts *HH*.
O, lighter lever, etc., for adjusting upward pressure of cone *I* and its plates *DD*, against the concave *G*.
JJ, wipers to discharge ground stuff.
L, feathers on upright shaft *K*.
M, step. *N P*, driving gear.
R R, fast and loose pulleys.
S, fly-wheel. *TT*, bolts holding cover.

Bone Black, Ar'ti-fi'cial. Woody matters impregnated with phosphate of lime dissolved in hydrochloric acid. The phosphates are thus distributed as they are in natural bones. The mass thus prepared is ignited. The difficulty consists in obtaining products of a sufficient density and mineral richness, and free from foreign salts. The charcoal obtained has to be washed in excess of water to remove chloride of calcium, if poor coprolites have been employed. — *M. Melsens.*

Bone Glass. A semi-translucent glass used for lamp-shades and globes. A proportion of bone dust is added to the frit, and it is supposed that the phosphate of lime remains suspended in the glass *Philip Fischer* in "*Glashutte.*"

The result resembles the cryolite glass, otherwise known as fused porcelain. See CRYOLITE.

Bone Hold'er. (*Surgical.*) A bone-grasping forceps, in some cases combined with a *rongeur*, or bone gnawer.

Dr. Darby's, Fig. 79, p. 24, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Bone In'stru-ments. (*Surgical.*) Those used in osteotomy, and in some cases of fracture and necrosis.

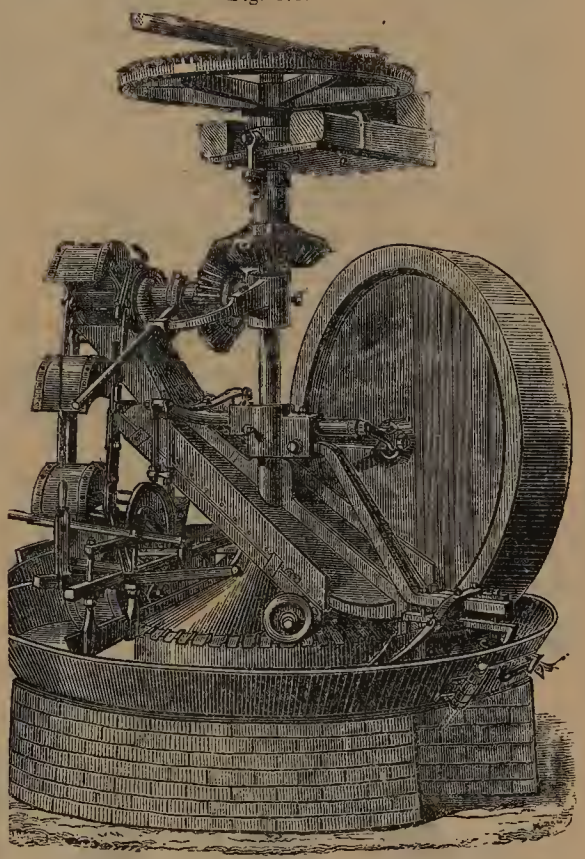
Among them are the following, which see : —
Bone drills.
Periosteotomes.
Exsection instruments.
Saws : Amputating, exsecting, subcutaneous, bow, circular, Hey's, metacarpal, bead, trephine, antrum drill, etc.
Osteophor ; forceps of various kinds and sizes.
Bone cutters, bone staffs, hooks and levators.
Trepanning elevator and raspatory.

Bone Mill. A machine for crushing bones for use, as animal charcoal in sugar processes, or for a fertilizer.

Fig. 377 is a vertical sectional view of Baugh's mill for crushing, grinding, and pulverizing bones, phosphatic rocks, minerals, ores, slags, etc.

Fig. 378 is a French bone mill on the Chilian principle. It resembles some forms of oil-mills, amalgamators, and cement mills, having an edge

Fig. 378.



Bone Mill. Jannot fils, Treil (Seine et Oise).

stone and scrapers. It has also an elevating device which lifts the stuff from the annular pan and discharges it down a screen and in front of the stone.

In the machine of Picksley, Sims & Co., of Manchester, England, the bones intended to be ground are thrown into the hopper, and after falling upon the cutting bed, they are pressed by feed rams against the teeth of a revolving cylinder in rapid motion. The reduced bones fall into an oscillating or revolving riddle attached to the mill, which separates them into two qualities, namely, dust, and half-inch bones. At the first operation the following proportions are obtained :

Dust	45 per cent.
Half-inch bones	30 per cent.
Coarser sample (to be re-ground) . .	25 per cent.

Davids' bone-mill is a disintegrator on the same principle precisely as the disintegrator (*Carr's*), Fig. 1655, "*Mech. Dict.*"

See the following references : —
Hull, Br. . . . . * "*Engineering*," xxx. 57.
Saville St. Foundry Co., Br. . * "*Engineering*," xxvi. 295.

See also article "*Engrais*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," Figs. 766, 767. Tome ii., ed. 1877.

See also FERTILIZER MILL ; GRINDING MILL ; ORE MILL ; DISINTEGRATOR ; CHILIAN MILL, etc.

Bone Saw. Stohlmann's bone saw, for surgical purposes, shown at Fig. 379, is a substitute for the chain saw, and consists of two handles connected by a wire of cast steel, on which is strung a series of steel beads with sharp cutting edges.

Fig. 379.

Stohlmann's Bone Saw.

Bone Por'ce-lain. (*Ceramics.*) A ware into the composition of which enters phosphate of lime in the form of bone dust.

Bone'si-late. A compound with a base of bone dust and an aggregating cement; used in place of ivory, real or artificial, or hard rubber, for buttons, door-knobs, billiard balls, etc.

It can be polished and colored, and is harder than celluloid.

It is much like the French material known as EBURINE, which see, refer to —

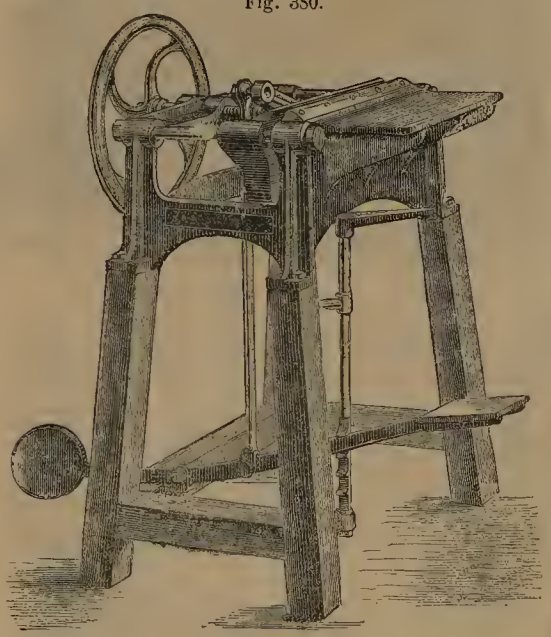
"*Scientific American*" . . . . xlii. 345.
"*Manufacturer and Builder*" . . xii. 111.
"*Iron Age*" . . . . . xxv., May 20, p. 26
"*Van Nostrand's Eng. Mag.*" . . xxiii. 263.

Bone Staff. (*Surgical.*) A director or retractor instrument with a curved end: serving to hold a bone while operating subcutaneously, or to replace fragments.

Figs. 63, 63 *b*, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Book Back'ing Frame. (*Bookbinding.*) A frame or vise in which a sewed book is placed to have the back rounded before being cased or covered. The jaws are brought together by pressure on the treadle, and the book back is rounded by the beating-hammer. The machine shown is French.

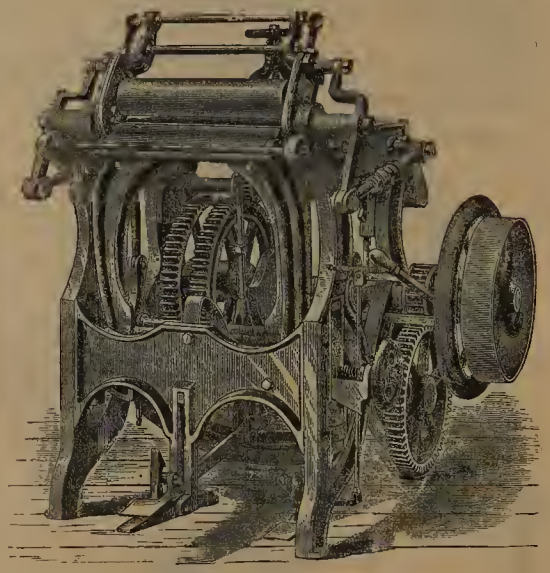
Fig. 380.



Book Backing Frame. (*Pierron et Dehaître, Paris.*)

Book Back'ing Ma-chine'. A machine for rounding the backs of books before casing or covering. An improvement on the hand-roller machine in respect of obviating the labor attached to the process of backing, excepting the placing of the book between the jaws and bringing a moderate pressure upon the treadle; the power then tightens the jaws, the roller passes over till the backing is completed, the jaws relax, and the book is taken out.

Fig. 381.



Power Book-backing Machine.

Book'bind-ing. Bookbinding machinery consists of sheet folding, signature sewing, edge cutting, back-rounding machines, presses, etc.

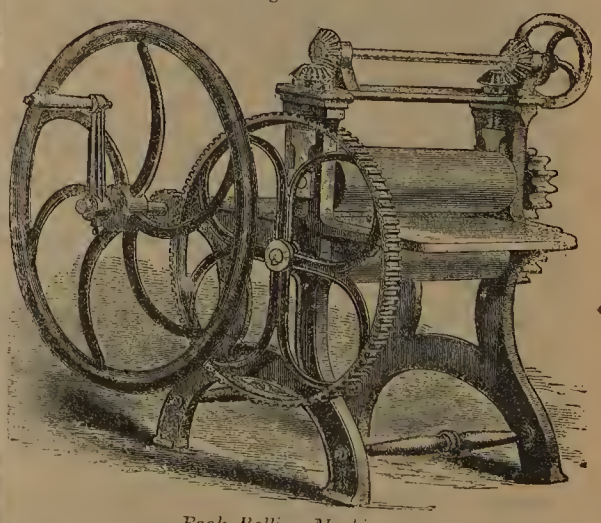
See list on pp. 330, 331, "*Mech. Dict.*"
See references: —

Schmitz . . . . . * "*Sc. Amer.*," xxxvii. 19.
Corner protector, *Way & Rankin*. * "*Sc. Amer.*," xl. 131.
Book factory . . . . . * "*Sc. Amer.*," xliii. 207.
Sewing machine. *Singer* . . . . * "*Sc. Amer.*," xxxv. 223.
Sulsberg . . . . . * "*Relieure*," "*Laboulaye's Dict.*," iii., Fig. 2331.
Stitching machine, *Neidlinger* . * "*Sc. Am. Sup.*," 1748.
See *Nicholson's "A Manual of the Art of Book-binding."*

Book'ing Ma-chine'. A machine for making up tobacco leaves into piles and packages.

Book Roll'ing Ma-chine'. A machine for rolling folded sheets instead of pressing them. The folded signatures being laid upon the platen are run between the rollers. The upper roller is ver-

Fig. 382.

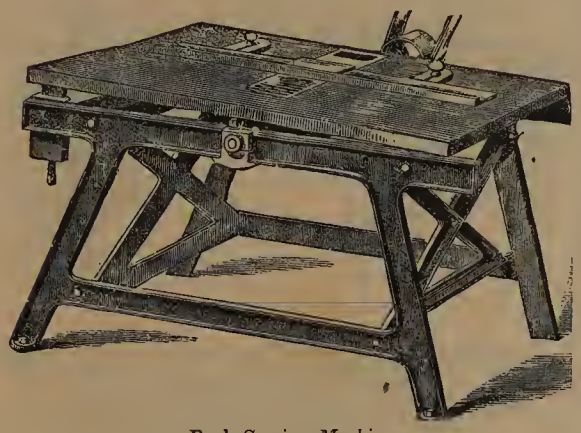


Book Rolling Machine.

tically adjustable, equally at both ends, by means of the hand-wheel and bevel-gearing.

Book Saw'ing Ma-chine'. A machine for sawing channels in the back of a pile of signatures

Fig. 383.



Book Sawing Machine.

to hold the cords to which the separate signatures are sewn. See SEWING PRESS, Fig. 4884, p. 2124, "*Mech. Dict.*"

The machine, Fig. 383, has a frame of cast iron, and a spindle of cast steel running in composition boxes. It has 5 saws adjustable on the mandrel to any length of book, and there firmly held by nut. The bed is planed smooth and hung on journals at one end, the free end being elevated to such degree as to give the required protrusion of the saws through the slots in the table. The fence or guide is adjustable, and held by set screws.

Book Sew'ing Ma-chine'. A machine for sewing signatures on to a band or cord for binding.

The book sewing machine of the Swiss inventor, Sulzberg, is described under article "Reliure," tome iii., Fig. 2231, *Laboulaye's "Dictionnaire des Arts et Manufactures,"* ed. 1877.

It folds by successive action between rollers in pairs, as in the ordinary folding machines; then pierces and sews the signature.

The Singer book-sewing machine takes sheets already folded and stitches them along the line of the final fold which is given them by a pair of rollers between which they are passed.

"*Scientific American*" . . . * xxxv. 223.

It is adapted for the stitching of signatures, but does not appear to be adapted to sewing them together to common bands or cords.

Smyth's sewing machine has as many stitches as cords, each being independent. The signatures are hung upon the horizontal arms of a four-arm reel which presents them, then drops, makes a quarter revolution, rises, and presents the next signature which hangs upon the next arm in succession. The signature is clamped, the row of needles come into operation, secure the signature, and the arm then drops away, and another is presented as before.

The Wheeler & Wilson book-sewing machine produces a book, the signatures of which are firmly united by loops of the band-thread, secured by a metallic pin within the center of each folded signature, each loop being so formed as to completely encircle the metallic securing pin.

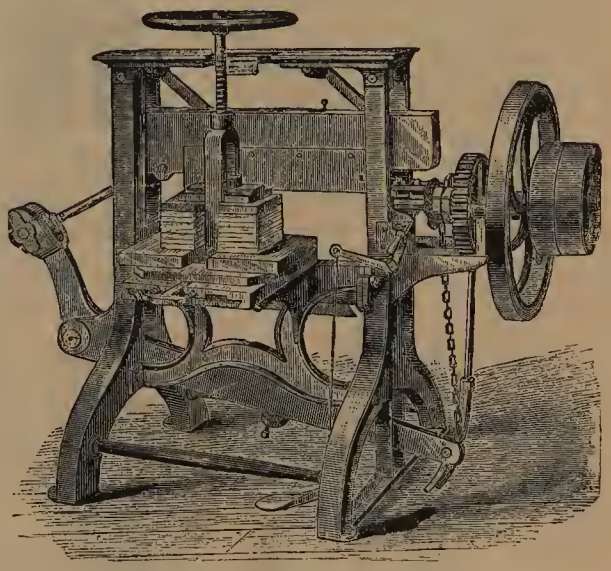
To operate the machine, the table in front of the bed is raised to its full height, the driving-wheel turned until the needles are above the throat-plates, the signature (opened) is then placed upon the needles, the pressers then force the signature firmly to the throat-plates, the needles recede, forming loops into which the material to form the securing pin is passed and severed; the needles now recede quickly, and by the loops of thread draw the securing pin down to the center of the signature, and the signature firmly upon the table in front of the bed. During this operation the arms above the bed recede far enough to permit that part of the signature which lay under them to be closed by means of a folder (placed in the rear of the needles), upon the part already drawn upon the table. This folder is provided with a projection from its lower front edge, which forces down the table upon which the signature is folded to a distance equal to the thickness of the signature last closed upon it, so that the top of the last signature is always in the same relative position to the bed and needles as was its predecessor during the time of sewing. To secure firmness of stitch, each thread is provided with tension devices, as is common to all sewing machines, and operates in a similar manner.

Book Stitch'ing Ma-chine'. Neidbruger's stitching machine for bookbinders is shown in "*Scientific American Supplement,*" * 1748. It operates on single signatures.

See also WIRE BOOK-SEWING MACHINE, Heyl's machine for fastening signatures to bands by means of wire staples.

Book Trim'mer. A machine for squaring the

Fig. 384.



Book Trimmer.

top, bottom, and front edge of a pile of books unbound. In the machine, Fig. 384, two of such piles are shown in the clamp, the backs of the books towards each other, so as to expose the other edges of each of the piles. The carriage being pushed up to position, the foot is pressed upon the treadle, when the knife quickly descends, making a draw-cut, and then at once returns to its starting-point. The pile is then withdrawn, rotated 90° to bring a new face to the knife, the cutting action repeated, and so on for each of the four faces.

The Standard Machinery Co.'s Steam Power Automatic Book Trimmer operates as follows:—Books are placed on the table, and clamped as with other trimmers; upon moving the shipper, the table advances to the knife, and the cut on one side is made, thereupon the table recedes, makes a quarter turn, advances again to the knife, again recedes, and so continues in operation till all four sides are cut, when the machine stops, the books can be removed, and a fresh lot substituted. As the table works perfectly free while cutting, and needs no attention, the operator is at liberty to get ready another lot of books, thereby saving a large proportion of time.

Boom. (*Lumbering.*) An artificially inclosed bay, in which logs are collected to prevent their drifting away by a current or tide.

The boom is usually made of spars or timbers chained together at the ends, and so anchored or staked as to inclose an area of water. A *boom* is found at each end of a *slide*, which is a chute to help logs over falls, rapids, or shoals. See, also, SHEER-BOOM.

Boom Sheet Block. The block through which the sheet of the boom is rove. In the example, Fig. 385, the block is double.

Fig. 385.

Double Block for Boom Sheet.

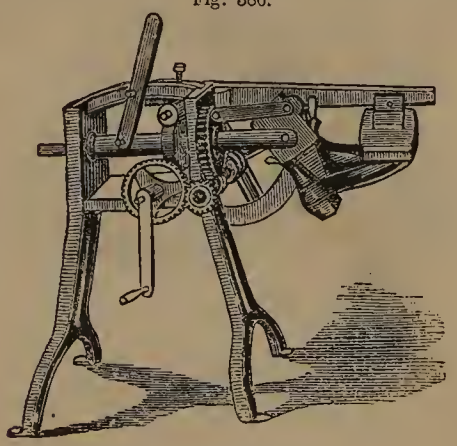
Boom Tack'le. (*Nautical.*) A tackle consisting of a double and single block and fall, used in rigging out or in a studding-sail boom.

Boot. 1. (*Surgical.*) Junot's dry cupping boot is a gum boot with an air-tight band on its upper border, and an air-pump to exhaust the air from around the leg. See DEPURATOR, "*Mech. Dict.*"; and AËROTHERAPY APPARATUS, *supra*.

2. (*Manége.*) A covering for any portion of a horse's leg; made of leather, or of felt and leather.

Boot Clean'ing Ma-chine'. A machine with expansible last to suit different sizes of boots, and with means for rotating the boot while the brush is briskly reciprocated upon it. The motions ar obtained by turning the handle,

Fig. 386.



Boot Cleaning Machine.

and the position of the boot is modified by the motion of the lever.

Kent's Boot cleaning machine. "*English Mechanic.*" "*Sc. Amer. Sup.*," 660.

Boot Sew'ing Ma-chine'. See SHOE MACHINERY; SOLE; HEEL, etc., and pp. 335–337, "*Mech. Dict.*"

Bor'der Knife. A knife for cutting the edges of grass plats, of grass borders to walks, of beds cut out of sod. Fig. 387.

Fig 387.

Border or Edging Knife.

Bor'ing An'chor. A method of setting piles for foundations or for anchorage by giving them a screw point or shoe, Fig. 388, which is sunk into the earth by rotation. See SCREW-PILE, "*Mech. Dict.*"

Bor'ing and Turn'ing Mill. A machine-tool which has its operative tools above while the work is chucked on a revolving bed below. It is a vertical drill or borer, or a horizontal lathe. The boring bars operate at all angles and have a quick return motion.

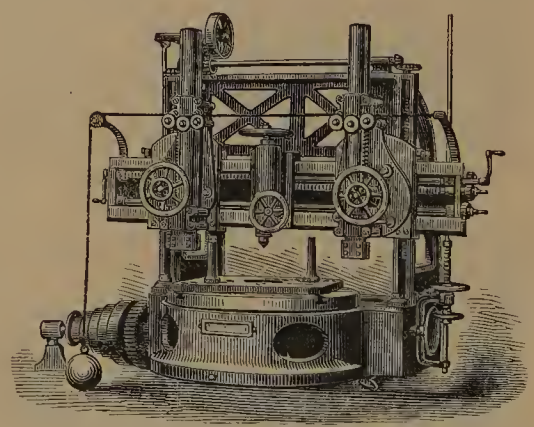
Fig. 388.

Bohlken's Boring Anchor.

The counterweight acts on a line directly through the center of the tool-holding bar. The swing of the large sized machines is 120″. The feeds are automatic in every direction; a disk driving a friction wheel, operates them, the rapidity of the feed is controlled by moving the friction wheel in or out on the surface of the disk, and the greatest or least change can be made instantaneously; and by removing the friction wheel across the center of the disk, the feed is reversed. The tool-holder admits of the tool being set in any way; it can be removed from the bar and any other form substituted. The face-plate rests in an annular bearing under its extreme outside edge; it has also a centerspindle, 12″ in diameter, and 5′ long, provided with a steel step; a taper key passes beneath this step, and the amount of vertical strain on the outside bearing can be regulated by turning a screw (the head of which is seen at the bottom of bed-plate), this is quickly accomplished, and is a valuable provision for setting work, boring and turning on smaller pieces, etc.; when a heavy or large piece of work is once set, a quarter turn of the screw communicating with the taper key brings the face-plate to its outside bearing, and the machine works with all the steadiness of a heavy planer and all the precision of the most accurate lathe.

The pulley turning attachments consist of the extra head, the equalizing driving plate with the two carriers (shown on the table), and the tail stock (shown on the cross rail).

Fig. 389



Boring and Turning Mill. (*Niles' Tool Works.*)

Bor'ing-bar Wrench. A wrench with a hook to fit the square of the boring bar or boring rod. It is to rotate it, and to hold it on occasion, as the

Fig. 390.

Boring-bar Wrench.

collar of the rod may rest on the wrench which lies upon the platform. See WELL-BORING TOOLS, pp. 2757, 2758, and Plate LXXIV. "*Mech. Dict.*"

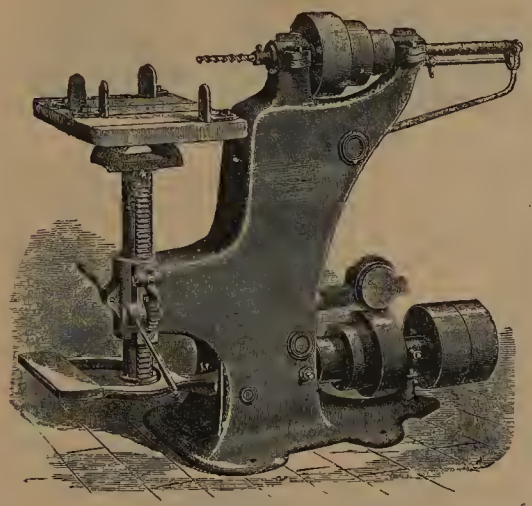
Bor'ing Head. A collet or head shod with black diamonds, and used in drilling bore-holes in rock. See DIAMOND DRILL, *"Mech. Dict."*

Fig. 391.

Annular Boring Head.

Bor'ing Machine'. Fig. 392 shows a boring machine which has three different speeds for large, medium, and small holes; can be adjusted to any angle or position, raised, lowered, and turned on its axis, inclined or revolved.

Fig. 392.



Universal Horizontal Boring Machine.

The following notices of machines may be consulted: —

Lathe attachment . .	* "*Scientific American*," xl. 404.
Rice	* "*Scientific American*," xxxix. 86.
Drilling, etc., *Bement* .	* "*Engineering*," xxii. 270.
	* "*Railroad Gazette*," xxi. 15.
Universal, *Bentel & Co.*	* "*Engineer*," xli. 412.
Horizontal, *Fay & Co.*	"*Thurston's Vienna Rept.*," iii. 264.
New, Br.	* "*Engineering*," xxii. 397.
Carpenter's, *Phillips* .	* "*Iron Age*," xxi., May 2, p. 42.
Richards & Atkinson.	* "*Iron Age*," xxiv., July 31, p. 1.
Jig-saw. *Robinson*, Br.	* "*Engineer*," xlv. 276.
Vertical, *Walker Bros.*	* "*Scientific American*," xxxvii. 326.
And spacing, *Colburn.*	* "*Manuf. and Builder*," xii. 235.
Tapers, boring . . .	* "*Scientific American*," xxxvii. 389.
And turning, *Bement* .	* "*Engineering*," xxiv. 254.
Bement	* "*Scientific American*," xxxvii. 306.
And grooving, *Atock* .	* "*Scientific American Sup.*," 356.
Cylinders, vertical . .	*Laboulaye's* "*Dict. des Arts et Manuf.*," i., Fig. 86, article "*Alesoir.*"

Bor'ing Rod. The rod which carries the drill in deep boring. Usually in sections united by screw-coupling or by socket and key. The illustration, Fig. 583, shows the latter method. See Plate LXXIV., opposite p. 2759, *"Mech. Dict."*

DEEP BORES AND SHAFTS.

Artesian well, Pottsdam, Mo.	5,500 feet.
Salt spring, Sperenberg, Prussia	4,175 feet.
Coal shaft, Viviers-Remus, Belgium . . .	3,542 feet.
Adelbert shaft, Pribram, Bohemia	3,280 feet.

See the following references: —

Food carrier for imprisoned miners,	
British	* "*Engineer*," xliv. 69.
Electric, *Planté* . . .	"*Telegraphic Journal*," vii. 120.
Europe, deep, *Jefferson* .	"*Van Nostrand's Mag.*," xix. 310.
Drawing rods	* "*Scientific American Sup.*," 1153.
Rod grapnel, *Allison*, Br.	* "*Engineer*," xliii. 165.

Bor'ing Tool.

See AUTOMATIC BORING-TOOL, for the Persian drill.

An expansion boring tool, in which a cutter is thrust out laterally for under-cutting, coring-out boxes, sweeps and curves, is shown in "*Scientific American*," * xxxviii. 181.

Van Haagen's expansion tool, instead of extending laterally at right angles, as in the one just mentioned, has a sweep upon an axis at right angles to that of the stock in which it is held.

Fig. 393.

Boring Rod.

Bor'ing Tools.

See under the following heads: —

Angle boring machine.	Expansion hollow-auger.
Angular bench-drill.	Fluted tap.
Angular bit-stock.	Gas-main drill.
Antrum trephine.	Gimlet.
Auger.	Gimlet bit.
Auger bit.	Gouge chisel.
Automatic boring tool.	Hand drill.
Barrel busher.	H drill.
Beuch drill.	Hollow auger.
Bit.	Lip auger.
Bit brace.	Marlinespike.
Blacksmith's drill	Nerve canal reamer.
Bodkin.	Nerve cavity instrument.
Boring tool.	Perforator.
Bow-drill stock.	Pin-bush.
Brace.	Plugger.
Breast drill.	Post auger.
Bung-hole borer.	Post-hole auger.
Chisel.	Post-hole digger.
Churn-drill.	Pricker.
Clutch drill.	Pump auger.
Combination auger.	Quick-speed hand-drill.
Corkscrew.	Ratchet brace.
Countersink.	Ratchet drill.
Crank rachet brace.	Reamer.
Dental drill.	Ship's auger.
Differential rachet brace.	Sinus probe.
Drill.	Slot borer.
Drill bench.	Spiral auger.
Drilling press.	Tap.
Earth borer.	Taper tap.
Equilibrium tool.	Track drill.
Excavator.	Trcenail auger.
Expanding drill.	Twist-drill.
Expanding reamer.	Worm auger
Expansion bit.	

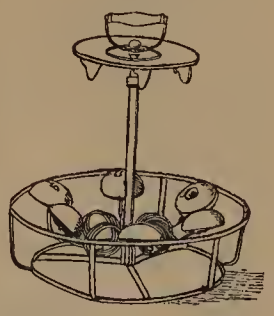
Bo'som Staff. An instrument used in testing the straightness of the faces of mill-stones.

The bosom of the mill-stone is a central depression, and the staff is adjustable to test the symmetry of the concavity.

Fig. 394.

Bosom Staff.

Fig. 395.



French Wine-bottle Carrier.

Bot'tle Car'rier. An appliance used in wine cellars in carrying uncorked bottles. A teat above enters the mouth, and the cup-shaped depression in the bottom of the bottle rests on the spring-pad.

Bot'tle Glass. (*Glass.*)

French Recipe: —	
River sand from the Rhône	100
Slacked lime	24
Sulphate of soda	8
Belgian Recipe: —	
Sand from near Charleroi	10
Peat ashes from Holland	20
Sulphate of soda	15
Limestone	5
Cullets (broken glass)	50
	100

France produces annually 100,000,000 to 120,000,000 bottles, representing a value of $4,000,000. The price is from $2.50 to $3.50 per 100 bottles of from 21 oz. to 2.20 pounds. Champagne bottles having to bear the pressure of the wine, cost from $4.60 to $5.60, according to quality.

The operation of blowing the bottle is as follows: —

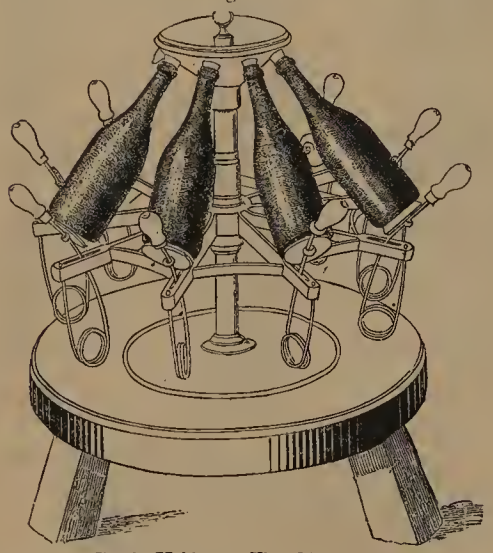
A piece of metal (melted glass) is gathered on the end of the *ponty*, is blown, swung, and rolled till brought to a given size (according to the description of bottle) and shape: then placed in a two-part mold (generally of iron), and by means of a compressing piston expanded against the inside of the mold which shapes it. When withdrawn from the mold the bottom is *pushed* (for some kinds of bottles); is detached from the *ponty* by cracking the glass by means of a piece of cold iron. The bottom of the bottle is put in a spring-tool; the neck is re-heated and the mouth properly shaped by a pincers which has forming blocks and fits the inside and outside of the mouth.

Sometimes the bottom alone is formed in the mold.

A furnace in France generally consumes about 374 pounds of coal for every 100 bottles of 28.80 ounce weight, or 1,320 pounds of coal for 220 pounds of bottles.

Bot'tle Hold'er. A stand for holding bottles, either in the bin or the rack — full or empty.

Fig. 396.



Bottle Holder. (*Vins Mousseux.*)

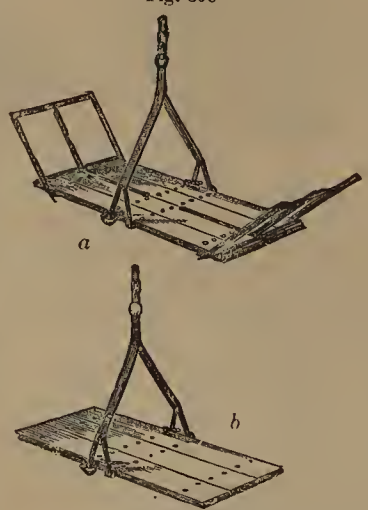
Fig. 396 is a French bottle-holder for holding the champagne bottles before wiring (*tourniquet porte bouteilles*). Made by Tricout & Cie., Reims.

Bot'tle Jack. A portable screw-jack in form of a bottle. Fig. 397. Also known as a cotton screw, from being used in packing bales on board ship.

Fig. 397.

Bottle Jack.

Fig. 398.



Scale Bottoms.

a. Folding bottom, for weighing goods in sacks.
b. Plain bottom.

Bot'tling Ap'pa-ra'tus. See —

Aërated water.
Hayward, Taylor & Co., Br. * "*Engineering*," xxvi. 351
Spencer & Gillman, Br. . * "*Engineer*," xlix. 235
Stopper, *Pochtler*, Austria . . * "*Sc. Amer.*," xxxix. 405.
Hart . . . . . * "*Sc. Amer.*," xliii. 310
Washer, *Cody* . . . . . * "*Sc. Amer.*," xliii. 374.

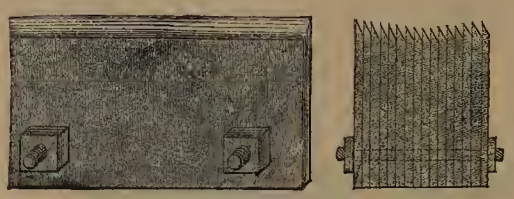
Bot'tom. 1. The support in a scale for the matter to be weighed. See Fig. 398.

2. (*Nautical.*) That part of a ship or boat below the wales.

Bot'tom-ing Tap. One for carrying the thread of full size to the bottom of the hole. See Tap *c*, Fig. 6211, p. 2495, "*Mech. Dict.*"

Bot'tom Plate. (*Paper-making.*) The gang of knives forming the concave or bed beneath the

Fig. 399.



Bottom Plate for Paper Mills.

cylinder of a rag-grinding machine or pulping engine. See Fig. 4020, p. 1824, "*Mech. Dict.*"

Bot'tom-set Line. (*Fishing.*) A line anchored at the ends. See Trawl Line, for instance.

Bouche. (*Nautical.*) Of a block. The bushing for the pin, in the cheeks of a block. The *coak* is the sheave bushing.

Bou'gie. (*Surgical.*) A smooth dilating instrument for *meati*.

See Fig. 838, p. 346, "*Mech. Dict.*," and accompanying description.

For varieties see the following, the figures refer to *Tiemann's* "*Armamentarium Chirurgicum:*" —

Bougie à boule	page 9, 11, Part III.
Bougie à trois nœuds	page 9, 11, Part III.
Bougie conique	page 9, Part III.
Bougie conique à ventre	page 9, Part III.
Bougie filiform	page 9, 11, Part III.
Bougie olivaire (olive shaped) . .	page 9, Part III.
Bougie olivaire à ventre	page 9, 11, Part III.
Bougie, œsophageal	page 84, Part III.
Bougie ointment	page 21, Part II.
Bougie (Otis's) à boule	page 11, Part III.
Bougie, pile	page 124, Part III.
Bougie, rectal	page 117, Part III.
Bougie, uretbral	page 6, Part III.

The terms *probe*, *dilator*, *divulsor*, *catheter*, etc., relate to thrusting instruments of various forms used for a variety of purposes. See list under Surgical Instruments.

Boul'der Crack'er. A heavy iron rod used in boring deep wells, to drop upon a bowlder which may be accidentally encountered in the boring, in order to crack it and allow the boring to proceed.

Bou-lin'i-kon. A floor covering; a substitute for carpet or floor-cloth.

It is constituted entirely of animal and vegetable fibre, animal hair and wool entering largely into its construction, and the whole being bound together by means of the skin of the buffalo, reduced to its natural fibre. These materials are formed into a thick cloth, and afterwards saturated with a solution of vegetable oxide and coloring matter, by means of which boulinikon is made almost as noiseless as carpet, while from the non-conducting nature of its elements, it is warm and comfortable to the feet.

Bow Ab-dom'i-nal Sup-port'er. (*Surgical.*) One having a bow-shaped spring to compress the abdomen, in place of obtaining the pressure by cincture.

Fig. 37, p. 16, Part IV., *Tiemann's* "*Armamentarium Chirurgicum.*"

Bow'er. (*Nautical.*) One of the large working anchors at the *bow*. They are called *best* bower

and *small* bower; not on account of size, but position.

The *best* bower is starboard.

The *small* bower is port.

Bowl. (*Fishing.*) The *pound, pot,* or *crib* of a weir or *pound net.* See POUND NET.

Bow'line Knot. (*Nautical.*) A combination of the reef-knot and carrick bend used for furnishing a bight that will hold upon a rope's end; as a bight on a boat's painter, to be thrown over a post on a wharf.

Fig. 400.

Bowline Knot.

A running bowline-knot has the knot made on the bight, instead of on the standing part, and makes a bight that travels upon the standing part.

Bow'line on a Bight. (*Nautical.*) A form of knot or bend. See 17, Fig. 2777, p. 1240, "*Mech. Dict.*"

Bow'sprit Shrouds. (*Nautical.*) Ropes or chains from the outer end of the bowsprit to the luff of the bow, giving lateral stay to the bowsprit.

Bow I'ron. One of the bow-shaped straps attached to the sides of a wagon body to hold the end of the bows on which the tilt is stretched and supported.

Fig. 401.

Bow Iron.

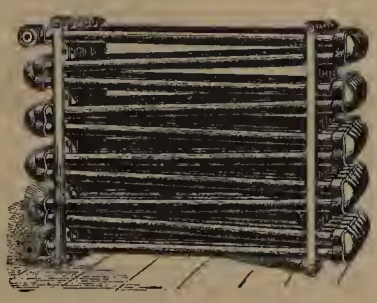
Bow Joint. One of the pieces concerned in the folding members of a carriage top.

Box Bar'row. A capacious, four-sided barrow, such as is used for carrying coke, saw-dust, etc.

"*Scientific American*" . . . *xxxix. 322, Fig. 7.

Box Coil. (*Heating.*) A steam or hot-water coil of many members, occupying a cubical space comparable in its proportions to a *box.*

Fig. 402.



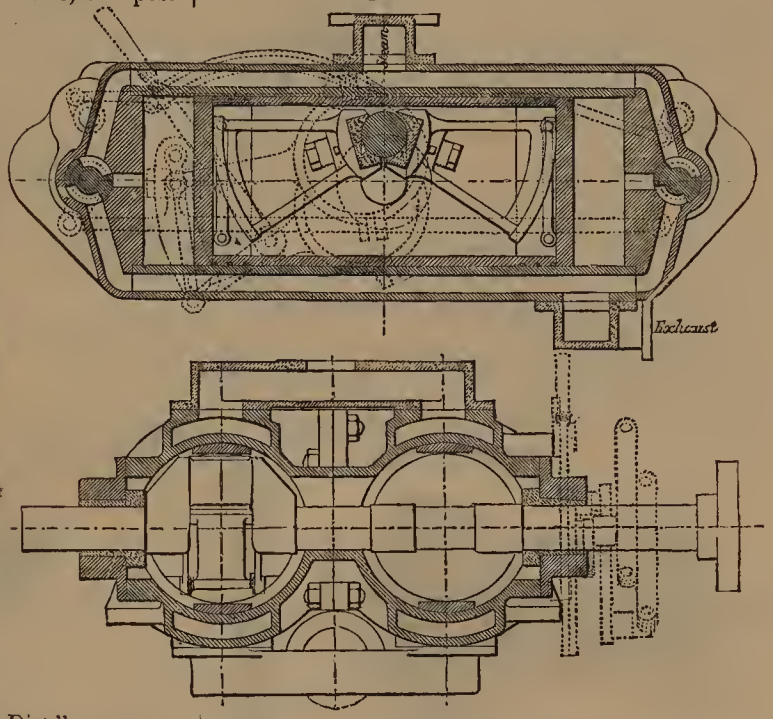
Box Coil with Return Bends.

Box En'gine. A peculiar form of engine in which the parts are all in compression, and which has but two joints. It is singularly compact, as a 25 horse-power engine, with steam at 65 pounds, occupies a space 14″ × 32″ × 13¼″, and weighs 364 pounds.

The engine consists of a cast-iron casing forming a cylinder traversed at the middle of its length by the crankshaft. The piston is formed of two rings connected by means of distance pieces, while a plate is secured to each end, and between these plates the sectors, which act as connecting rods, move freely.

The use of these sectors or quadrants in place of the ordinary connecting rods forms one of the features of the engine. The sectors roll on the inner faces of the piston plates, and

Fig. 403.



Outridge's Box Engine.

are supported by bridle rods of wrought-iron, the wearing parts are case-hardened, and the pins on which they move are of steel. In the ends of the sectors are fitted the crank-pin brasses, so arranged that they may easily be set up until they are completely worn through; the motion of the arcs of the sectors being a rolling motion, there is practically no friction. The brasses of course are under the same conditions as those of an ordinary engine.

The valves used are of cylindrical form, having passages for the inlet and outlet of the steam, one valve being placed at each end of the cylinder. They are held between centers of hardened steel (as they do not bear on the shell there is very little if any wear) and are actuated by an eccentric attached to a rod connected to both by means of short levers; the motion of the eccentric causes the valves to vibrate. The engine is solely under the control of the reversing lever, and may be stopped, started, reversed, or linked up with the greatest ease, the valves always being in equilibrium.

The clearance spaces are small, the amount being only one fortieth part of the cubic contents of the cylinder, as compared to one twelfth part, which is the general practice in small engines of the ordinary type. This object is gained by the use of very short steam ports, the general practice being to make the ports ¾″ in length.

A lubricator is fitted on the steam-pipe and the oil is carried past the valves into the interior of the cylinder in the usual manner. An oil cup is also fitted to the hand-hole door, by means of which oil is introduced between the inner faces of the piston-plates; in this the crank-pin is partially submerged at each revolution, the splashing caused by the passage of the crank through the oil thoroughly lubricates all the working parts inclosed within the diameter of the cylinder, and oilways are cut in the bearing brasses, through which the oil constantly trickles and thereby reduces the chances of hot bearings. When once the lubricator has been charged and a proper quantity of oil placed between the piston-plates, the engine will run for twenty-four hours without attention.

See the following references: —

*"*Engineer*" . . . . . xlv. 55.
*"*Engineering*" . . . . . xxv. 52.
*"*Scientific American Supplement*" . . 1805.

Box Form'ing Ma-chine'. A machine for forming sheet-metal boxes, such as those for condiments, baking powder, cocoa, etc.

"*Iron Age*" . . . . . *xx., November 22, p. 1.

Box Hook. 1. A hook used in handling boxes; somewhat like a cotton-hook, which see.

2. A hook made on the plan of a cant-hook; used in closing boxes packed full of fish.

3. Hooks used in pairs in swinging boxes from a lifting-tackle. Fig. 404.

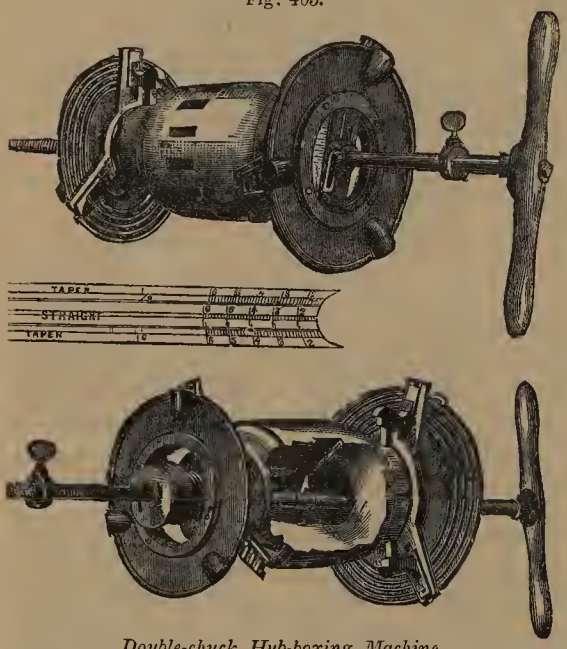
Fig. 404.

Box Hooks.

Box'ing Ma-chine'. A machine for boring out the boxes of hubs. Fig. 405. It is adjustable to bore either a straight or taper hole.

The upper figure shows the chuck for the larger end, with the device for varying the taper of the hole. The lower figure shows the chuck for the smaller end, and also shows the interior, a portion of the hub being broken away to expose it. The adjusting rule, shown between the figures, enables the operator to set the bits for cutting a straight hole or one with any required taper.

Fig. 405.



Double-chuck Hub-boxing Machine.

Box Man'gle. One of which the weight is formed by a box containing stones or blocks. Fig. 3043, p. 1383, "*Mech. Dict.*"

Box Pack'ing. Fibrous waste saturated with oil for the packing of axle boxes.

Box Re'lay. (*Electricity.*) A portable relay instrument which is inclosed in a box.

Box Scra'per. A tool for scraping names off boxes for re-addressing.

Fig. 406.

Box Scrapers.

The illustration shows a double handle scraper, a single handle scraper, and an adjustable scraper with plane bit.

Box Valve. A box section in a pipe containing a valve, and having a cover for access. Fig. 407.

Bra-bant' Plow. A peculiar form of plow, made either single, double, or turning-mold-board.

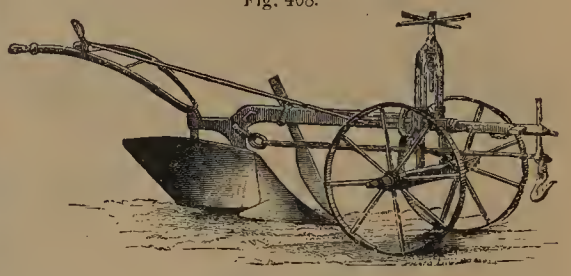
It is named from Brabant, in Flanders, and is rapidly spreading over the North of France. Whatever may be the peculiarity of the mold-board, one or more, the plow has always its beam adjustable in the standard of the avant-train.

Fig. 407.

Greenhouse Box Valve.

See —
Knight's "*Report, Paris Exposition,*" * v., Figs. 4, 25–28, 49.
"*Scientific American*" . . . . . * xxxix. 163.

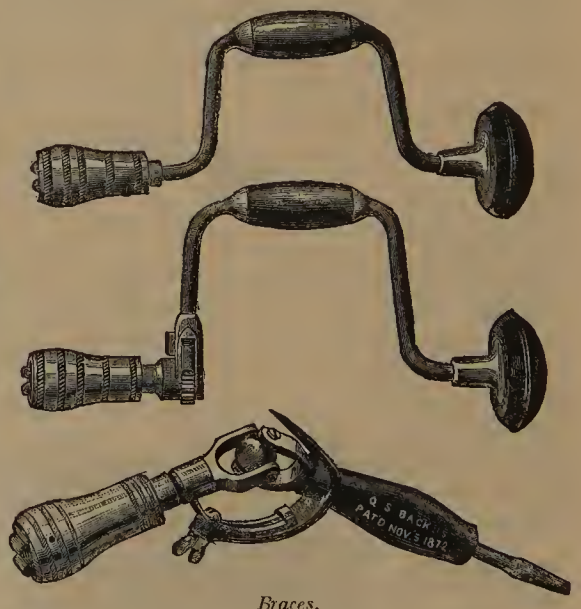
Fig. 408.



Brabant Single Plow.

Brace. 4. (*Add.*) A revolving tool-holder, of which three forms are shown in Fig. 409: Straight,

Fig. 409.



Braces.

Ratchet, Angular. An *extension* brace is one with a lengthening section for very deep holes.

8. (*Mining.*) (*Add.*) *b.* The platform over the mouth of the shaft or winze, and to which the tackle is hooked.

Brace Tre-pan'. (*Surgical.*) A trephine saw mounted on a brace: in effect, an annular bit in a brace.

Fig. 72, p. 20, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Brack'et Cock. One projecting from a wall in manner of a bracket, as distinguished from one on a post rising from the basin slab. Fig. 410.

Brack'et Cut'ting-off' Saw. A cross cutting saw mounted on a projecting bracket, its arbor traversing to and fro so as to carry the saw across.

the stuff which lies upon the table beneath. Fig. 411. The table has rollers to facilitate the endways motion of the timber between cuts.

Fig. 410.

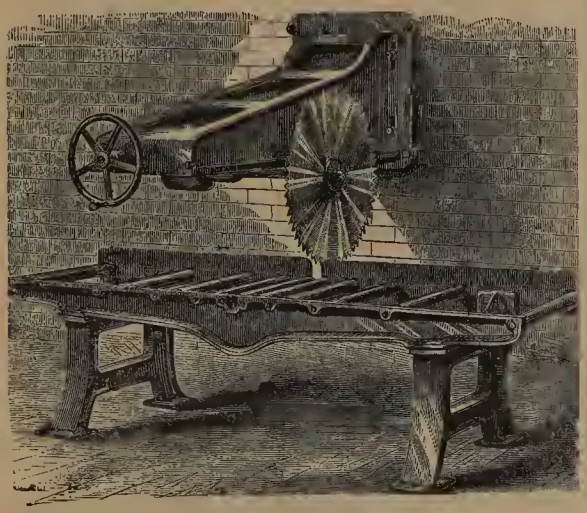
Bracket Basin Cock.

The machine is specially designed for car and bridge shops, ship-yards, etc. The bracket is adjustable vertically on the wall-plate, to compensate for the wear of the saw. The saw carriage is gibbed to the ways, and the traverse movement is by rack and pinion connected with the hand-wheel in front. The traverse is 38″; sawing capacity for boards is 30″ wide, and for timbers 12″ × 24″.

Brad Driv'er. An instrument, Fig. 413, especially designed for nailing moldings to the panels of doors. It has a brad-holder and a plunger driven by a mallet.

Bra-doon'. (*Manége.*) A small bit having loose rings; used as a second bit for bearing reins in curb bridles. *Gag bradoons* have holes in the rings through which a strap is passed, the ends of which are connected with the reins; when made in this way they are very severe, and are used only for riding bridles. *Link* and *T bradoons* are bits having links or T-s attached

Fig. 411.



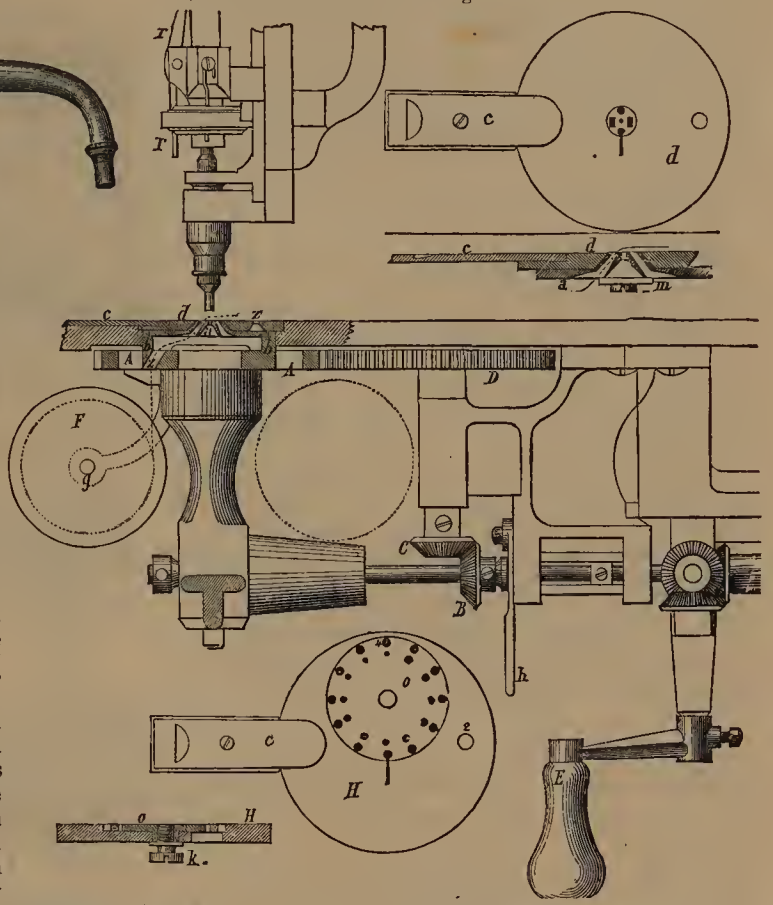
Bracket Cutting-off Saw, with Traversing Arbor.

to the rings, by which the head collar is attached; they are used only for military purposes; bradoons are made with stiff and with jointed mouths.

Braid'ing Ma-chine'. A machine which sews braid on to cloth. A species of embroidering machine.

Cornely's braiding machine (Paris) is founded upon the Bonnaz embroidering machine, having combined with the latter a braiding apparatus which presents the braid to the needle always in the direction of the feed, so that it will stitch it to the cloth in its center.

Fig. 412.



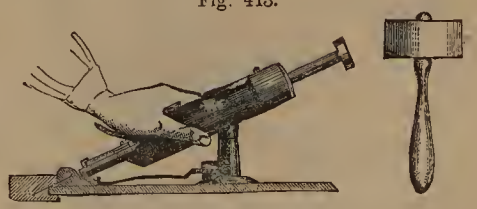
Cornely's Braiding Machine.

The braiding apparatus consists of a braiding disk *a*, which is fitted within the rim or crown of the large wheel *A*. Upon turning the crank handle *E*, the wheels *B*, *C*, *D* turn the wheel *A* and the braiding disk *a*, which presents the braid to the needle always in the direction of the feed.

To use the braiding apparatus a braiding guide must be selected, through which the braid can slide easily. Braiding disks are adapted for the respective sizes of braid.

Withdraw the slide *c*, raise the plate *d* by inserting the curved point of the hook knife into the hole, lift the end of the braid by means of the wire-hook through the slot *Z*, in wheel *A*, and draw it through the braiding guide. Place the spool *F* on its spool-holder, *g*, and the India-rubber washer upon the end of the spool-holder to prevent the spool from sliding off. Set the braiding disk *a* upon the rim of the wheel *A* and in such a manner that its projection *m* enters into one of the recesses of said rim

Fig. 413.



Thorndike's Brad Driver

It is very important that the guide from which the braid issues should always be in a true radial line with the feed lever *r* of the machine, and that the braid should fit nicely in said guide, or else it will not be stitched in its center; it should, however, not be too tight in the guide, as in that case it would draw and ruffle the material.

In case it should be necessary to adjust the braiding guide it can be done by adjusting the position of the wheel *A*. To accomplish this, raise the lever *h*, and push the wheel *B* to

the right, thus the wheel *C* becomes free, and the wheel *A* can be turned independently of the crank handle *E;* adjust the braiding disk to its true position, push the wheel *B* against the wheel *C* and lock it by means of the lever *h*.

The braid should always pass from below the spool *F* into the passage *Z*, as shown in dotted lines, and never from above the spool, as it will bear against the side of the passage *Z* and thus draw or ruffle the material.

For embroidering purposes a plate, *H*, is supplied with each machine, and is to be used instead of the plate *d*.

To change the needle-hole in plate *o*, loosen the screw *k*, push the disk *o* out of plate *H*, turn it until the needle-hole to be used will be in the center of plate *H*, and push it home into the plate *H*, taking care that the tooth 4 enters one of the notches in the circumference of disk *o*, and tighten the screw *k*.

The *Wheeler & Wilson* new No. 10 sewing-machine is a perfect braider.

Brain Knife. (*Surgical.*) A knife used in making sections of the brain in *post-mortem* examinations and for microscopic purposes.

Fig. 326, p. 95, Part I., "*Tiemann's Armamentarium Chirurgicum.*"

Braize. Charcoal powder. It accumulates around charcoal works at furnaces, and is a source of danger. Suggested to be blown into the furnaces of the hot blast. — "*Mining Journal.*"

Brake. 1. (*Railway.*) See Air Brake, Vacuum Brake, etc. For details of various car-brakes, see *Forney's "Car-builders' Dictionary."*

2. In casemate and ships' guns: a compressor to check the recoil of a gun. See description on pages 500, 501, "*Ordnance Report,*" 1877.

3. (*Manége.*) A severe bit, formerly used in England. It is referred to by Nares.

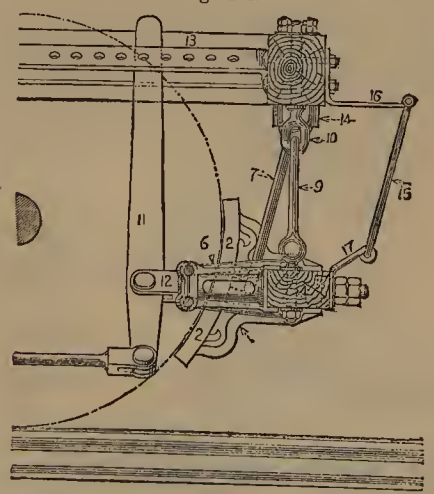
4. A form of testing device. See Dynamometer; Dynagraph, "*Mech. Dict.,*" *et infra.*

See, also: —

Automatic friction
Becker, Austria . . . *"*Scientific American Sup.,*" 3996.
Car (for tests).
Westinghouse . . . *"*Engineer,*" xlv. 380.
*"*Engineer,*" xlv. 402.
Car for testing.
Westinghouse . . . *"*Engineering,*" xxv. 470.
Continuous . . . . *"*Engineering,*" xxiv. 262, 363, 369.
Sanden . . . . *"*Engineering,*" xxi. 241.
Railway, *Massauge* . *"*Van Nostrand's Mag.,*" xxii. 9.
For locomotives.
Hickey . . *"*Scientific American Sup.,*" 1600.

Brake Beam. (*Railway.*) The suspended beam to which the brake shoe is immediately attached. — *Forney.*

Fig. 414.



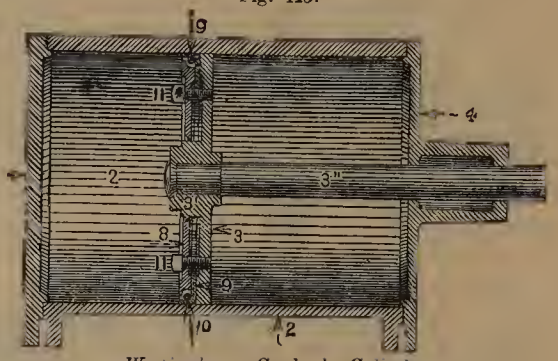
Trussed Brake Beam, Hanger, and Carrier.

The parts concerned are as follows: —

2. Brake-block.
4. Trussed break-beam.
7, 9. Brake hanger and link.
11. Brake lever.
13 Brake lever-stop.
15, 16. Parallel brake.

Brake Cyl'in-der. (*Railway.*) The air cylinder of a brake arrangement; containing the piston against which the compressed air works to move the brake lever. — *Forney.*

Fig. 415.



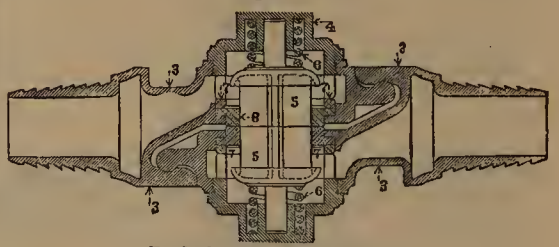
Westinghouse Car-brake Cylinder.

The parts are as follows: —

2. Cylinder.
3. Piston, 3″ piston-rod.
8. Follower-plate.
9. Packing leather.
10. Packing expander.
11. Follower bolt.

Brake Hose-coup'ling Valve. (*Railway.*) In the clutch-coupling of the Westinghouse brake. A puppet-valve which is contained in a chamber in a coupling-case to prevent the escape of air from the hose when the latter are uncoupled. — *Forney.*

Fig. 416.



Brake-hose Clutch-coupling.

3. Coupling case
4. Coupling cap.
5. Coupling valve.
6. Valve spring.
7. Packing ring-washer.
8. Packing-ring.

Brake Pur'chase. A lever power for working a windlass. A pair of pivoted sockets receive

Fig. 417.

"Amazeen" Beam.

the handspikes and act alternately upon the central lever, which has rod connection to the clutches on the windlass beneath the deck.

Brake'-shoe. The rubber in a car-brake arrangement.

The Congdon brake-shoe has pieces of wrought iron cast into the general surface of the cast iron shoe, to give it greater adherence.

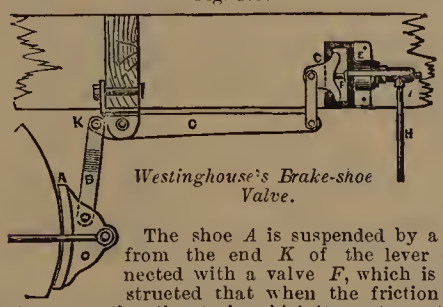
Fig. 418.

Brake-shoe.

Brake'-shoe Valve. A valve arranged to be operated by the

brake shoe when the friction on the brake-shoe exceeds the amount sufficient to skid the wheels.

Fig. 419.



Westinghouse's Brake-shoe Valve.

The shoe *A* is suspended by a link *B* from the end *K* of the lever *C*, connected with a valve *F*, which is so constructed that when the friction of the brake-shoe, or rather the strain which it exerts on the link *B*, exceeds an amount assumed to be sufficient to skid the wheels, the valve will release some of the air in the brake cylinder, and thus reduce the pressure on the piston and on the brake-shoes. When the car is running in one direction the strain on the link *B* will of course be downward, and when running in the opposite direction the strain will be upward.

"*Railroad Gazette*" . . . . . * xxiii. 99.

Branch. A bifurcated pipe, known as a Y, from the similarity of form to that letter.

a. Branch or Y.

b. Double Y.

c. Reduced Y; one of the arms being of smaller diameter.

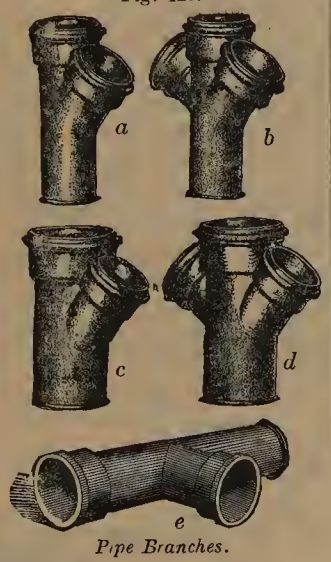
d. Reduced double Y; both the subsidiary pipes being of smaller diameter than the main stem.

e. T-branch.

When it leads to lateral water-closet hoppers, it is known as a *soil branch*, which see.

See also BEND, HUB, etc., and list on page 1708, "*Mech. Dict.*"

Fig. 420.



Pipe Branches.

Bran Ma-chines'. For clearing flour from bran, for packing, baling, etc.

See the following references: —

Baler, *Kennedy*	* "*American Miller*," viii. 198.
Cleaner, *Davario*, Switz.	* "*Engineering*," xxx. 250.
Mills	* "*American Miller*," vii. 209.
Dresser, *Lanton & Arndt*	* "*American Miller*," viii. 197.
	"*American Miller*," viii. 332.
	"*American Miller*," vii. 188.
Duster, *Bradfield & Oliver*	* "*American Miller*," v. 54.
Dresser	"*American Miller*," vi. 108.
Duster, *Hughes*	* "*American Miller*," vi. 77.
	"*American Miller*," vi. 144.
Rakes	* "*American Miller*," viii. 115.
Package	"*American Miller*," viii. 377.
Packer, "Eureka," *Mattison*	* "*American Miller*," v. 93.
	"*American Miller*," v. 88.

Brass. An alloy of copper and zinc. See pp. 358, 359, "*Mech. Dict.*"

A native brass is found on the south fork of the Yuba River, California, analyzing as follows (*Stillman*): —

Copper	85.02
Zinc	11.02
Antimony	3.82
Iron	0.09
	99.05

"The specimens are in the form of small, somewhat flattened, concretionary masses, from ⅜ to ¼ centimeters in diameter, and destitute of apparent crystalline structure. Color, from dark red to ash-brown to yellowish-white; streak, faint yellowish-white; specific gravity, 8.33; somewhat brittle; slightly incrusted with green carbonate of copper." — "*Mining Record.*"

See *Larkin's* "*Practical Brass and Iron Founder's Guide*," 12mo.

Recipes: —

	Tin.	Zinc.	Copper.	Lead.
Hard. *Chantrey's*	5	5	32	–
Castings	–	16	32	3
Lathe	2	33	65	–
Malleable	–	43	57	–
Button	–	15	24	–
White	1	2	16	–
Red	–	1	9	–
Red. *Hegermuhl*	–	2	11	iron.
Nails	–	16	20	2
Red sheet	–	2	9	old br
Gear wheels	3	–	32	2
Turning	4	–	32	3
Pumps	3	1	32	–
Sheathing and bolts	–	4	6	–
Soldering	–	6	16	–

On brass, *Kirk*	"*Iron Age*," xxi., Mar. 14, p. 5.
Blackening	"*Sc. American*," xxxiv 386.
Brassing, Electro	"*Iron Age*," xxii., Dec. 5, p. 3.
Coloring	"*Scientific Amer.*," xxxiv. 276.
Thurston's expts. in	"*Sc. American*," xxxvii. 65.
Furnace	* "*Iron Age*," xxi., Mar. 28, p. 5.
Filings separator	"*Eng. & Min. Jour.*," xxx. 91.
Malleable	"*Scientific Amer. Sup.*," 2662.
Manufacture, *Benedict, et al.*	* "*Scientific Amer.*," xlii. 271.
Coloring and finishing	"*Scientific Amer.*," xli. 281.
Works, *Scoville Co.*	* "*Scientific Amer.*," xli. 375.
Brazing furnace	* "*Sc. American*," xxxviii. 404.
Brazing burner	* "*Iron Age*," xxv., May 27, p. 3.

Brass Black'ing. A dead black color; used freely with French optical instruments.

Make a strong solution of nitrate of silver in one dish, and of nitrate of copper in another. Mix the two and plunge the brass. Remove, and heat evenly until the required dead blackness is obtained.

Brass Col'or-ing. Surface coloration by lacquer or chemical action.

To obtain —

Browns of all shades, immerse in solution of nitrate or perchloride of iron, the strength of the solution determining the depth of the shade.

Clean the brass, leave in damp sand, then polish with a dry brush.

Violet: Dip in solution of chloride of antimony.

Chocolate: Burn on the surface of the brass moist red oxide of iron, and polish with graphite.

Olive Green: Make the surface black by means of a solution of iron and arsenic in muriatic acid, polish with a black-lead brush, and coat, when warm, with a lacquer composed of one part of lac varnish, four of turmeric, and one of gamboge.

Green and light coating of Verdigris: Dilute acid, followed by spontaneous drying.

Orange, inclining to gold: Polish, and plunge for a few seconds in a warm, neutral solution of acetate of copper.

Grayish Green: Dip in a bath of copper.

Moire: Solution of sulphate of copper.

Steel-gray Bronze: Dilute boiling solution of chloride of arsenic.

Blue Bronze: Strong hyposulphite of soda.

English Brass Color: Heat to redness, dip in sulphuric acid, then in dilute nitric acid, wash, dry in saw-dust.

Black Bronze: Coat with solution of platinum, or chloride of gold mixed with nitrate of tin

Japanese Bronze: Solution of sulphate of copper, alum, and verdigris.

Black: Polish with tripoli, wash with solution of nitrate of tin, 1; chloride of gold, 2

Or, dip in bath obtained by dissolving copper filings in nitric acid; then heat over charcoal; repeat to develop color.

Or, mix a strong solution of nitrate of silver in one dish and nitrate of copper in another, mix the two, plunge the brass, heat to develop color.

The following is a recipe which gives to brass a variety of shades, according to the length of the exposure or the amount of the application. First appears a light color, then all shades successively from red, dark blue, light blue, and finally brown: Dissolve 60 grains bitartrate of potassa in a liter of

water, to which add 30 grains tin salt (protochloride of tin) dissolved in a fifth of a liter, heat to boiling, and allow the resulting precipitate to settle. The clear liquid is now to be poured, under constant stirring, into a solution of 180 grams of hyposulphite of soda in one fourth liter of water, and again heated to boiling, during which operation a quantity of sulphur will be separated. The resulting clear solution is then ready for use.

Old German Recipe: The sulphide of copper produces similar effects.

Brass Fin'ish-ing.

See article from "*Ironmongers' Review*" (Br.) on Brass Finishing, including —

Turning.	Bronzing.
Spinning.	Lacquering.
Burnishing.	Etc.
Coloring.	

Reproduced in "*Iron Age*," xxi., May 9, p. 7.

Brass'ing. Electro-brassing is done by first washing in hot potash bath, then pickling the article to obtain a clean metallic surface, free from oxide, and removing the black scale by scouring, and then exposing in the depositing bath with strong battery power.

The methods employed for brassing cast iron, zinc, steel, are detailed by Mr. Alex. Watt, and reproduced in "*Scientific American Supplement*," 2610.

Brass Lac'quer-ing. A means of preserving brass from tarnishing without giving it an artificial color. (For the latter see BRASS COLORING.)

The brass is pickled, scoured, and washed; dipped in nitrous acid for an instant, washed in clean water, dried in saw-dust. Then dipped an instant in nitric acid, washed in a weak solution of argol, and dried in warm saw-dust.

"So prepared, the goods are conveyed to the lacquer room, where they are heated on a hot plate and varnished.

"The varnish used is one of spirit, consisting, in its simple form, of one ounce of shellac dissolved in one pint (imperial) of methylated spirits of wine. To this simple varnish are added such coloring substances as red sanders, dragon's blood, and annatto, for imparting richness of color. To lower the tone of color, turmeric, gamboge, saffron, Cape aloes, and saudarach are used. The first group reddens, the second yellows the varnish, while a mixture of the two gives a pleasing orange.

"A good pale lacquer consists of three parts of Cape aloes and one of turmeric to one of simple lac varnish. A full yellow contains four of turmeric and one of annatto to one of lac varnish. A gold lacquer, four of dragon's blood and one of turmeric to one of lac varnish. A red, 32 parts of annatto and eight of dragon's blood to one of lac varnish.

"Lacquers suffer a chemical change by heat and light, and must, therefore, be kept in a cool place and in dark vessels. The pans in use are either of glass or earthenware, and the brushes of camel's hair, with no metal fittings." — *Ironmongers' Review*

Lacquer for small arms and bright work of ordnance is made of turpentine, oil, and beeswax, sometimes with the addition of litharge or of resin. In the latter cases the compound is really a paint or a varnish, and the term lacquer is a misnomer.

Brat'tice Cloth. A cloth used in a mine in place of a brattice of plank.

Proposed to be made of wire cloth, so as to prevent being burned by explosion or other accident.— "*Mining Journal.*"

"*Scientific American Supplement*," 948.

Bray'-plank. (*Grain Mill.*) The beam supporting the adjustable end of the bridge-tree.

Bra'ziers' Hearth. An open fire used by braziers.

For particulars and suggestions, see *Kirk's* article in "*Iron Age*," xxi., May 9, pp. 3, 5.

Fig. 421.

Brazing Blow-pipe.

Braz'ing Blow-pipe. A brazing blow-pipe used by Dr. Cryer in his lectures on continuous gum and other dental work, is shown in Fig. 421.

In this bench apparatus the blow-pipe attachment is connected with the main tube by a swiveling gas-joint. The air is admitted at *A*, passing through a small tube enclosed in the gas-pipe *B*. The supply of gas is regulated by the stop-cock *C*.

See article by Edward Kirk, "*Iron Age*," xxi., May 9, p. 3.

Braz'ing Tongs. A flat, heavy jawed tongs used in brazing band-saws. The tongs, being heated in the furnace, is clapped upon the scarfed ends of the saw, between which a slip of solder is laid. See Fig. 199.

Bread Sli'cer. A guillotine knife, working in a guide, to cut slices from a loaf. The BEEF SHAVER (which see) is a similar implement.

Athearn's bread slicer descends in oblique guides so as to make a draw-cut.

Anderson's is a detached knife with guides, which merely direct it vertically.

Break. 4. (*Architecture.*) (*Add.*) *b.* A part of a wall projecting, to destroy the continuity and diversify the line.

(*Add.*) 7. (*Mining.*) A fissure or crack found in the vicinity of old workings, caused by the subsidence of the strata.

8. (*Electricity.*) An opening in the circuit, preventing the passage of electricity.

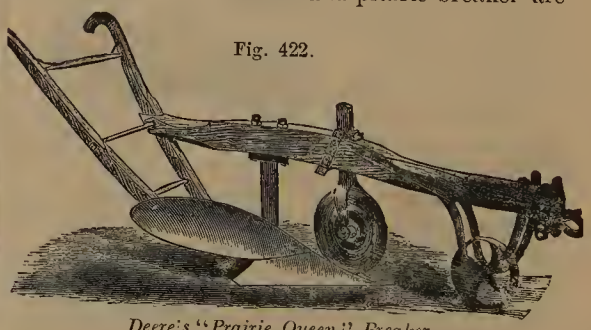
Break'-cir'cuit. (*Electricity.*) An arrangement on an electro-magnetic or magneto-electric instrument, by which an operator can open or close the circuit at pleasure.

Break'-down Van. A British name for a wrecking car, sent to clear and repair the track after derailment of a train or cars.

Break'er. A plow adapted for breaking new ground, as distinguished from a stubble plow or sod plow.

The timber land breaker and prairie breaker are

Fig. 422.



Deere's "Prairie Queen" Breaker.

essentially different, the former more nearly approximating the normal plow. The latter is shown in Fig. 422. In construction it is light and strong, and, like plows of its class, turns a flat furrow. It has a slip-share, wrought frog, and adjustable 3-horse clevis.

Break'er Card. The first carding machine which receives weighed quantities of cotton upon its feeding apron and forms it into a lap. The second carder is the *finisher*.

Break'ing-down Ma-chine'. (*Gunpowder.*) A machine used in the manufacture of gunpowder to break the lumps of crude powder into a fine state of division, to facilitate the operation of pressing.

The breaking-down machine consists of a pair of gun-metal, cylindrical rollers, grooved longitudinally. They are placed side by side, their axes horizontal and parallel. The journal boxes of one roller are adjustable, and held in position by a weight. They revolve in opposite directions, and

break the powder into a meal. A second pair completes the operation.

See "*Ordnance Report*," 1879, Appendix I., Plate III., Fig. 6, and description on p. 102.
* "*Engineering*," xxv. 95.

Break Lathe. (*Mach.*) One having a gap in its bed to increase the *swing*, or capacity for turning objects of large radius. In the Whitworth self-acting break-lathe, a very large face plate is used, and the tail stock is mounted on a supplementary bed, and has the usual adjustments. See also GAP-BED LATHE.

Break'wa-ter.

See the following references: —

Block Island . .	"*Scientific American*," xl. 342.
Bruggeman . .	* "*Scientific American Supplement*," 397.
St. Michael, Azores	"*Scientific American Supplement*," 210.

Breast Rope. (*Nautical.*) A band fastened between the shrouds for the safety of the man in the chains when sounding. He leans against it when reaching over to let the lead swing clear.

Breath Bat'te-ry. (*Electricity.*) A thermo-electric battery adapted to be used as a transmitter in a telephone circuit.

"*Scientific American Supplement*" . . . . * 2552.

Breech'-load'ing Fire'-arms. Norton's report in quarto on American breech-loading fire-arms, contains notices of the following arms (* illustrated): —

Breech loader. Temp. Henry II., of France.
Matchlock revolver. Temp. Henry II., of France.
Snap-hammer self-loading petronel. Temp. Charles I., Britain.
Breech-loading rifles. Temp. Henry VIII., Britain.
Breech-loading arm. Hall, Britain, 1664.
Breech-loading arm. Hall, United States, 1811.

Breech-loader, —	Breech-loader, —
Ferguson,* 1776.	Earnest.*
Remington.*	Milbank.*
Peabody.*	Spencer.*
Ward-Burton.*	Maynard.
Springfield.*	Hammond.*
Joslyn-Tomes.*	Roberts.
Berdan,* converted.	Ball-Lamson
Berdan,* bolt.	Broughton.
Whitney.*	Meigs.*
Revolver, Smith & Wesson.* Colt.	Machine gun, Gatling.*

The following guns were subjected to the tests of the Board of Ordnance. See Ordnance Memoranda, No. 15, where they are described and illustrated.

LIST OF ARMS.

No. 1.	Wooden model	Edwin Sleeper.
2.	Musket, cal. .50 . . .	B. S. Roberts.
3.	Carbine	W. T. Scott.
4.	Magazine-carbine . . .	W. R. Evans.
5.	Musket, cal. .50 . . .	Sharps' Rifle Co.
6.	Wooden model	F. W. Worrell.
7.	Musket, cal. .50 . . .	Peabody Rifle Co.
8.	Musket, cal. .433 . . .	Peabody Rifle Co.
9.	Carbine, cal. .50 . . .	Peabody Rifle Co.
10.	Musket, cal. .50 . . .	E. Whitney.
11.	Musket, cal. .50 . . .	E. Whitney.
12.	Musket, cal. .50 . . .	E. Whitney.
13.	Musket, cal. .50 . . .	E. Whitney.
14.	Musket, cal. .42 . . .	J. D. Greene.
15.	Carbine, cal. .42 . . .	William Morgenstern.
16.	Musket	Frederick Wohlgemuth.
17.	Musket	Frederick Wohlgemuth.
18.	Musket, cal. .50 . . .	John Broughton.
19.	Musket, cal. .50 . . .	E. Remington & Sons.
20.	Musket, cal. .50 . . .	E. Remington & Sons.
21.	Musket, cal. .50 . . .	E. Remington & Sons.
22.	Musket, cal. .50 . . .	E. Remington & Sons.
23.	Musket, cal. .50 . . .	E. Remington & Sons.
24.	Musket, cal. .50 . . .	W. H. Elliot.
25.	Musket, cal. .50 . . .	A. T. Freeman.
26.	Musket, cal. .50 . . .	Ward-Burton.
27.	Carbine, cal. .50 . . .	Ward-Burton.
28.	Carbine, cal. .50 . . .	B. S. Roberts.
30.	Musket, cal. .50 . . .	C. M. Spencer.
31.	Musket, cal. .50 . . .	E. Remington & Sons.
32.	Musket, cal. .50 . . .	W. S. Smoot.
33.	Musket, cal. .50 . . .	Oscar Snell.
34.	Musket, cal. .42 . . .	S. F. Van Choate.
35.	Musket, cal. .52 . . .	W. H. Robertson.
36.	Musket, cal. .50 . . .	Capt. J. M. Whittemore.
37.	Musket, cal. .50 . . .	John L. Kirk.
38.	Musket, cal. .50 . . .	Smith & Chamberlain.
40.	Musket, cal. .50 . . .	B. F. Joslyn.
41.	Musket, cal. .43 . . .	E. Remington & Sons.
42.	Musket, cal. .50 . . .	Updegraff.
43.	Musket, cal. .50 (Ryder extractor)	E. Remington & Sons.
44.	Musket, cal. .50 . . .	James F. Thomas.
45.	Musket, cal. .50 . . .	John Broughton.
46.	Musket, cal. .42 . .	Wesley Richards.
47.	Musket, cal. .50 . . .	Schofield-Remington.
48.	Musket, cal. .50 . .	Springfield, mod. 1870.
48½.	Carbine, cal. 50 .	Springfield.
49.	Wooden model	Alfred Beals.
50.	Musket, cal. .50 . . .	J. M. Milbank.
51.	Musket, cal. .50 . . .	J. M. Milbank.
52.	Magazine-musket, cal. .44	Stetson.
53.	Musket, cal. .50 . . .	James Lee.
54.	Musket, cal. .50 . . .	James Lee.
55.	Wooden model	G. R. Remington.
56.	Revolving carbine . . .	Helm.
57.	Musket, cal. .42 . . .	Berdan-Russian.
58.	Magazine-carbine, cal. .45	Ward-Burton.
59.	Musket, cal. .50 . . .	A. T. Freeman.
60.	Musket, cal. .58 . . .	Mont-Storm.
61.	Musket, cal. .50 . . .	James Lee.
62.	Musket, cal. .50 . . .	Oscar Snell.
63.	Musket, cal. .50 . . .	Peabody.
64.	Musket, cal. .50 . . .	B. S. Roberts.
65.	Musket, cal. .50 . . .	Earnest.
66.	Musket, cal. .50 . . .	Springfield-Stillman.
67.	Musket, cal. .50 . . .	Remington-Ryder.
68.	Musket, cal. .50 . . .	Springfield-Allin.
69.	Musket, cal. .50 . . .	Springfield.
73.	Carbine, cal. 50 . . .	Springfield.
74.	Wooden model	J. B. Rumsey.
75.	Carbine, cal. .50 . . .	B. S. Roberts.
76.	Musket, cal. .50 . . .	A. T. Freeman.
77.	Carbine, cal. .50. . . .	E. Whitney.
78.	Repeating musket, cal. .45	Winchester.
79.	Musket, cal. .42 . . .	John Broughton.
80.	Carbine, cal. .50. . . .	W. H. Elliot.
81.	Musket, cal. .50 . . .	Sharps' Rifle Co.
82.	Locking rifle, cal .50 . .	Remington.
83.	Musket, cal. .50 . . .	Merrill.
84.	Musket, cal. .50 . . .	William Conroy.
85.	Navy rifle, cal. .50 . . .	Remington.
86.	Musket (Ryder extr.) .45	Remington.
87.	Magazine-musket, cal. .42	William Gardner.
88.	Musket, cal. .45 . . .	Springfield.
97.	Magazine-musket, cal. .45	Ward-Burton.
99.	Musket, cal. .45 . . .	Springfield.

Brew'ing. Consult arrangements in the following references: —

Australian	* "*Engineer*," l. 346.
Fountain, *Pontifex & Wood*, Br. .	* "*Engineering*," xxix. 34.
Machinery, vats, coolers, etc., Br.	* "*Engineer*," xlviii. 259.
Austriau brewery plant (48 figs.)	* "*Engineer*," l. 266, 303, 404, 458, 462.
Sectional view, *Cannock Co.*, Br.,	* "*Engineer*," xlix. 62.
Steam "Phœnix," New York . .	"*Sc. Am. Sup.*," 952.

See *Byrn's* "*The Complete Practical Brewer.*"
Erné's "*Theoretical and Practical Chemistry of Fermentation.*"
Schützenberger "*On Fermentation.*"

Brew'er's Fau'cet. A faucet with two brass cocks.

A double faucet: that is, two faucets from a single stem which enters the barrel or vat, and a small faucet at the fork for sampling. A RACKING FAUCET, which see.

Brick Bar'row. A flat-bottomed, sideless, high front board wheelbarrow, for off-bearing bricks, and conveying baked bricks to the kiln. The wheel is set farther back than usual, and the bricks piled in ranks on each side.

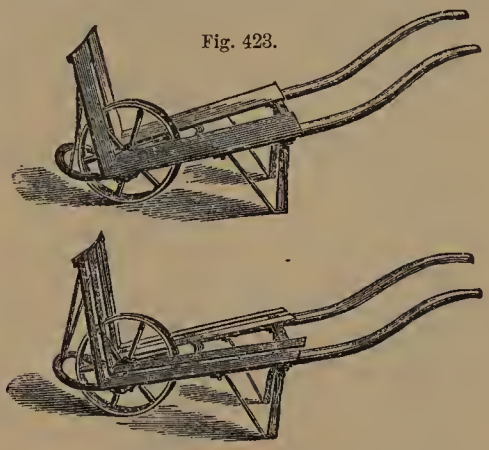
Brick, Hol'low. A brick with cells, for ventilation or to prevent passage of moisture. See Figures 897–899, "*Mech. Dict.*"

French hollow bricks are made by Gaillon, Levallois-Perret, and Hugede, Faubourg St. Honore, Paris. See also article "*Briques Creuse*," and Figs. 3438–3441, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877.

Brick Kiln. Two systems of continuous kilns for burning bricks, tiles, etc., have come into prac-

tical use — the French system of Colas, also known as that of Borie (Fig. 901, p. 371, "*Mech. Dict.*"); and the German system of Hoffmann, the well-known annular kiln or Ringoven (Fig. 903, *Ibid.*).

Fig. 423.



Brick Barrows.

The prineiple of the kilns of Colas, Borie, and their imitators, consists in plaeing the air-dried bricks on small railway trucks forming a long train. This is slowly moved through an arched chamber, provided in its center with fixed fireplaces for burning the bricks; the fire in these kilns is stationary, while the bricks are moved forward. The principle of the Hoffmann kiln is just the reverse; here the bricks are stacked in an annular burning chamber, and remain stationary while the fire travels through them, leaving burnt bricks in the rear and advancing into and among the green bricks. The annular shape of the burning chamber allows a continuous operation of the kiln, the fire progressing in the circuit without interruption, while the burnt bricks behind the fire are continually replaced by green bricks. The first-named system is also worked continuously, the train being supplied in the rear with trucks containing green bricks, at the same rate as trucks with burnt bricks are withdrawn in the front.

On the *Colas* principle is the *Dueberg* kiln described in —
"*Engineer*". . . . . * xlvi. 191.
"*Scientific American Supplement*" * 2358.

The Foster kiln, for which see —
"*Engineer*" . . . . . * xlvi. 385.
"*Scientific American Supplement* . * 2071, 2546.

Of kilns on the Hoffmann principle are the *Lancaster*, "*Scientific American Supplement*," * 2357.
Hoffmann, "*Vienna Exposition Report*," vol. iv., p. 20.
Hoffmann, Laboulaye's "*Dictionnaire*," i., art. "*Briques.*"
See also "Continuous Brick Kiln" (Br.), "*Engineer and Mining Journal*," xxv. 348.

Hamilton's perpetual brick kiln has a number of compartments arranged in a line and divided by a sheet-iron door, capable of being raised or lowered, so as to let the heat pass from one to the other.

Adams' Brick kiln (patent July 21, 1868) has steam introduced into the furnaces to distribute the heat through the interstices of the stack of bricks.

Brick'lay-ers' Ham'mer. A hammer for trimming bricks for caps, lintels, quoins, etc. The art of ornamental brick-work can be scarcely said to exist in the United States. Such edifices as exist in Turin and other cities in Northern Italy have no parallel on this side of the Atlantic.

Fig. 424.

Bricklayer's Hammer.

Bricklaying machine.
Franke . "*Sc. Amer. Sup.*," 149.

Brick Ma-chine'. A machine for molding bricks.

See Report of Gen. *Q. A. Gillmore*, "*Centennial Exhibition*," vol. iii., Group II., p. 184.

The subjects are divided into: —

Dry clay machines. Tempered clay machines.
Crude or moist clay machines. Slush or mud machines.

Includes description of the machines of

Garretson . . . . . * p. 186.
Morand . . . . . * p. 187.
Chambers Bros & Co. . . . . . * p. 188.
Tiffany . . . . . * p. 193.
Durand & Marais . . . . . * p. 195.
Schlickeysen . . . . . * p. 197.
Gard . . . . . * p. 200.
Gregg . . . . . * p. 204.
"Peerless" . . . . . * p. 206.
"Combination" (*Gregg*) . . . . . * p. 212.
"Excelsior" (*Gregg*) . . . . . * p. 214.
"Triple Pressure" (*Gregg*) . . . . . * p. 215.
Aiken . . . . . 220.

See also Figures 908-920, pp. 371-378, "*Mech. Dict.*," where brick machines of three classes and six sub-varieties are described and illustrated. Branches of the subject are also considered under PUG-MILL, CLAY-MILL, TILES, etc.

A short *resumé* is in "*Scientific American*," xxxviii., 202.
See also "*Guide du Briquetier*," par *M. E. Lejeune*, Paris.

Ancient bricks, "*Builder*," "*Van Nostrand's Mag.*," xix., 353, and page 368, Figures 895, 896, "*Mech. Dict.*" See also *Wilkinson, Rawlinson, Lepsius*, etc.
See "*Brick and Tile Making*," Dobson.
"*Bricklayers' Tables*," Laxton.

The following references to Brick Machines may also be consulted: —

* "*Iron Age*," xxi., February 14, p. 1.
English . . . . * "*Scientific American*," xxxvii. 399.
Allemand . . . . * "*Scientific American Sup.*," 3869.
Armitage & Iter, Br. * "*Engineer*," xlix. 342.
Boulet Bros., Fr . * "*Scientific American*," xli. 50.
Bradley & Craven, Eng. . . . . * "*Scientific American Sup.*," 2176.
Brownhill, Br. . . * "*Engineer*," xliii. 299.
Brownhill . . . . * "*Scientific American*," xxxviii. 211.
Brownhill, Eng. . . * "*Scientific American Sup.*," 1236.
Craven, Eng. . . * "*Scientific American Sup.*," 627.
Durand & Marais . * "*Engineering*," xx. 261.
Durand & Marais . * "*Scientific American Sup.*," 172.
Gard . . . . . * "*Scientific American*," xxxvii. 287.
Gregg . . . . . * "*American Manf.*," April 4, 1879, p. 7.
Gregg, Br. . . . * "*Manufacturer and Builder*," xi. 76.
* "*Scientific American Sup.*," 627.
* "*Polytechnic Review*," April, 1876.
Gregg Represser . * "*Scientific American*," xl. 243.
Machen Rotary . . * "*Scientific American*," xxxvi. 271.
Newbold, Fr. . . * "*Iron Age*," xix., March 29, p. 1.
Peerless Brick Co. . * "*Manufacturer and Builder*," ix. 53.
Penfold, Eng. . . * "*Scientific American Sup.*," 1059.
Stubbs, Br. . . . * "*Engineering*," xxii. 251.
Talcott . . . . . * "*Scientific American*," xlii. 406.
Vanier . . . . . * "*Scientific American*," xxxviii. 115.
Warner & Lee, Br. . * "*Engineering*," xxvi. 302.

Bridge. See the following data and reference to technical journals of the period, 1876-80: —

Tay Bridge, Scotland, commenced 1871, finished 1877. Partially destroyed by a gale. Total length, 10,321′, 85 spaus: the 13 over the channel 245′ each, and 88′ above high water.

Syzran and Orenburg Railway Bridge over the Volga. Total length 4,732′ feet; 13 spans of 364′ each. Piers 80′. high above the water. Ice cutters 35′ high. Cost $3,500,000.

Forth Bridge, Scotland (projected). Total length, 7,860′ Two suspension spans 1,600′ each over deep channels. These are united by 2 spans of 165′ each, and each by 3 spans to anchorage towers, which are connected respectively to the north shore by 9 spans, and the south by 14 spans. Total spans, 33. The channels are 186′ and 210′ deep. The highest towers, 597′ high. The suspension spans 150′ above high water.

Railway Bridge in British India. Total length, 9,300′, 64 spans of 142′ each. Brick and iron.

Poughkeepsie Railway Bridge over the Hudson (building). 4 piers, two of which are founded, respectively 112′ and 97′, below the surface. Piers 130′ above the water; depth of truss 60′. Railway track 190′ above the water.

Cincinnati Southern Railway Bridge, over Kentucky River. Total length, 1,125′. Three spans 300′, 375′, 300′. Shore spans, 150′ each. Height above water, 275′.

The height of the Niagara Railway Bridge track above the water is 250′.

A Swiss bridge with a span of 154′ is 254′ high.

One on the Andes has a span 125′, and is 252′ high.

"Albert," Montreal, St. Lawrence (proposed), 15,000′, nearly 3 miles; one span between 500′ and 600′; height, 130′ above high water; estimated cost, $4,000,000.

"Victoria," St. Lawrenee, Montreal. Tubular. Total length, 10,380′. Two abutments and 24 piers; 25 spans Channel span, 330′; the others, 242′ each. 60′ above summer level of water. Cost, $1,250,000. Commenced 1854, finished 1859.

Wesel Bridge, over the Rhine, has a total length of 6,220′, including 4 spans of 313′ each.

The Graudeuz Bridge, over the Vistula, has 12 spans of 300′.

See list of 22 suspension bridges, p. 2464, "*Mech. Dict.*"
The following are the lengths of longest spans of the iron, tubular, and girder bridges cited : —

Place.	Feet.	Builder.
Tay	245	
Susquehanna River	307	Phœnix Bridge Co.
Vistula, Graudenz	300	
Rhine, Wesel	313	
Lessart, France	314	
Ohio River, Steubenville	319	J. H. Linville.
St. Lawrence River	330	Rob't Stephenson.
Ohio, Parkersberg	342	J. H. Linville.
Rhine, Maycnce	345	Gerber.
Volga, Orenburg Railway	364	
Ohio, Louisville	368	Albert Fink.
Kentucky River	375	C. S. Smith.
Ohio, Louisville	396	Albert Fink.
Vistula, Dirschau	397	Lentze.
Conway, N. Wales	400	Rob't Stephenson.
Ohio, Cincinnati	415	J. H. Linville.
Inn, Passau	420	
Saltash	455	I. K. Brunel.
Menai Straits	460	Rob't Stephenson.
Hudson, Poughkeepsie	500	
Lek, Holland	515	G. Van Diesen.
Ohio, Cincinnati	518	J. H. Linville.

To this may be added the list of bridges over the Mississippi, between Winona and St. Louis.

At	When built.	No. Spans.	Longest Span, feet.	Draw.
Winona	1871	16	240	160
La Crosse	1876	10	240	160
Prairie du Chien	1875	–	Pontons	–
Dubuque	1868	8	240	160
Clinton	1865	14	180	118
Rock Island	1871	7	250	160
Burlington	1868	10	200	160
Keokuk	1870	12	240	160
Quincy	1868	24	160	160
Hannibal	1871	8	240	160
Louisiana	1873	11	256	200
St. Louis	1874	3	515	None

The following notices may be consulted : —

Arched Masonry . . . . . "*Sc. Am. Sup.*," 664.
Ashtabula, Railway . . . . . * "*R. R. Gaz.*," xxi. 86.
Ashtabula, Railway . . . . . "*Sc. Am. Sup.*," 961.
Bascule . . . . . * "*Man. & B.*," xi. 29.
Beaver, Penn., Truss . . . . * "*R. R. Gaz.*," xxiv. 540.
* "*Engineer*," l. 498.
Belgium, Revolving . . . . * "*Sc. Am. Sup.*," 744.
Blackwall, Railway . . . . * "*Engineer*," xli. 408.
Bosphorus, *Eads & Lambert* . . "*Technologiste*," xl. 38.
Brisbane, Australia, Truss . . * "*Engineering*," xxi. 553.
"*Sc. Am. Sup.*," 152.
Brooklyn, "Clefbridge," Béton * "*Man. & B.*," x. 29.
Chinese, Suspension . . . . "*Sc. Am. Sup.*," 691.
Canada, Credit Valley . . . . * "*Engineering*," xxx. 154.
Derwent, England, Iron Arch . * "*Sc. Am. Sup.*," 2830.
Douro, Portugal, Truss Arch * "*Eng'ing*," xxi. 110, 149.
* "*Engineering*," xxv 457, 463, 485.
* "*Eng'ing*," xxvi. 39, 416.
* "*Engineer*," xlv. 409, 446.
* "*Engineer*," xlvi. 39, 94.
* "*Sc. Amer.*," xxxix. 103.
* "*Sc. Am. Sup.*," 1425.
* "*Eng. & Min. J.*," xxv. 308.
Dublin, Arch . . . . . * "*Sc. Am. Sup.*," 1264.
E. River, N. Y., Suspension, Cost * "*Sc. Amer.*," xxxvi. 64.
Footway . . . . . * "*Sc. Amer.*," xxxvi. 143.
Serving the cable . . . . * "*Sc. Amer.*," xxxix. 287.
Cable drums, etc. . . . . * "*Sc. Am. Sup.*," 754.
* "*Sc. Am. Sup.*," 899.
East River, Blackwell's Island . * "*Sc. Am. Sup.*," 1172.
Forth, Railway, Proposed, *Bouch* * "*Engineer*," xlviii. 314.
1600′ span . . . . . * "*Eng'ing*," xxix. 153, 173.
Hamburg & Harburg Ry. . . . * "*Engineer*," xlix. 104.
Hudson River . . . . . "*Sc. Am. Sup.*," 627.
Iwakuni, Japan . . . . . * "*Sc. Amer.*," xxxvii. 151.
Kennebec, Me . . . . . * "*Engineering*," xxvi. 8.
Kentucky River, *Bouscaren* . . * "*R. R. Gaz.*," xxi. 403, 413, 423, 433.
* "*Sc. Am. Sup.*," 1503.
"*Technologiste*," xxxix. 119.
Kuilenburg, Holland, Truss . * "*Am. Manuf.*," June 25, 1880, p. 8.
Laughery Creek, Ind., Truss . * "*Engineering*," xxix. 222.
Lee, Cork, Lifting Span . . . * "*Engineering*," xxix. 450.
Louisville . . . . . * "*Engineer*," xlii. 360.
Manawater, New Zealand . . . * "*Sc. Am. Sup.*," 1542.
Manchester, Eng., *Fowler* . . * "*Sc. Am. Sup.*," 1094.
Salford, Eng. . . . . * "*Engineer*," xlix. 442.
* "*Sc. Am. Sup.*," 1204.
Manchester, Br. . . . . * "*Engineer*," xliii. 148.
* "*Engineer*," xliii. 233.
Marseilles, Swing . . . . . * "*Engineer*," xlvi. 206, 222.
Matina River, Costa Rica . . . * "*Eng'ing*," xxix. 24, 48.
Medway, Engl. . . . . * "*Sc. Am. Sup.*," 1540.
Montreal, "Royal Albert" . . * "*Engineering*," xxi. 256.
"*Engineer*," xli. 149, 174.
"*Sc. Am. Sup.*," 17.
Nile, *Kohé* . . . . . * "*Engineering*," xxviii. 132, 144.
Orange Riv., Cape of Good Hope * "*Engineering*," xxvii. 371.
Oxley Creek, Queensland . . . * "*Engineer*," xlii. 414.
Penn. Railway, examples . . * "*Engineering*," xxiii.
Freight transfer . . . . * "*Eng'ing*," xxiv. 22, 28.
Philadelphia, Callowhill St. . . * "*Sc. Am.*," xxxiv. 271.
Carriage, 40th St. . . . . * "*R. R. Gaz.*," xxi. 75, 109.
Girard Avenue . . . . . * "*Sc. Am. Sup.*," 28, 49.
Lansdowne Valley, Fairmont * "*Engineering*," xxi. 90.
* "*Sc. Am. Sup.*," 674.
Over Penn. R. R. . . . . * "*Sc. Am. Sup.*," 1055.
Pittsburg, Arched truss . . . * "*Engineering*," xxi. 528.
Iron . . . . . * "*Sc. Am.*," xxxv. 143.
Monongahela, *Wilson* . . * "*Eng'ing*," xxx. 274, 290.
Suspension . . . . . * "*Sc. Am. Sup.*," 533.
Plattsmouth, Neb., Mo. . . . * "*R. R. Gaz.*," xxiv. 640.
Portage, N. Y. . . . . "*Sc. Am. Sup.*," 458.
St. Charles R. R. . . . . * "*Sc Am.*," xxxiv., 162.
St. Louis & Illinois . . . . * "*Sc. Am.*," xli. 379.
* "*Sc. Am. Sup.*," 125.
St. Maurice, Can. . . . . * "*Eng'ing*," xxvi. 175, 182.
Sarpsfos, Norway . . . . . * "*Eng'ing*," xxv. 10, 26, 61.
Severn, England . . . . . * "*Engineering*," xxxviii. 314, 322.
"*Sc. Am. Sup.*," 1490.
Susquehanna, Penn., Railway . * "*Engineering*," xxx. 490.
Sutlej, India, "Empress" . . * "*Eng'ing*," xxvi. 454, 486.
Tay, Scotland, Entire, broken . "*Engineer*," xlix. 1.
Site . . . . . * "*Engineer*," xlix. 21.
Piers . . . . . * "*Engineer*," xlix. 26, 30, 230, 264.
Piers . . . . . * "*Iron Age*," xxv., Jan. 29, p. 1.
10,321′ . . . . . "*Man. & B.*," ix. 120.
* "*Engineering*," xxii. 531.
* "*Engineering*," xxix. 88.
"*Sc. Am. Sup.*," 713.
"*Sc. Am. Sup.*," 1541.
Thames, New, London . . . . * "*Sc. Am.*," xxxviii. 329.
* "*Sc. Am.*," xxxviii. 361.
Old, London, history, etc. "*Sc. Am. Sup.*," 290.
Proposed, Tower . . . . * "*Engineering*," xxiii. 457.
* "*Engineer*," xlv. 217, 220.
* "*Engineering*," xxvii. 411.
High level . . . . . * "*Engineering*," xxviii. 50.
London . . . . . "*Van Nostrand's Mag.*," xxiii. 434.
Vescovali, Rome, Treatise on . "*Van Nostrand's Mag.*," xxiii. 331.
Volga, Syzran, Rus., Railway . * "*Engineering*," xxx. 4, 626, 30, 52, 72.
Wear, Eng., Railway . . . . * "*Engineer*," l. 368.
Yardleyville . . . . . * "*Sc. Am. Sup.*," 615.
Zwartkops River, S. Africa . . * "*Eng'ing*," xxviii. 477.

Also : —

American iron . . . . . "*Sc. Am. Sup.*," 500.
On historical, "*Building News*" "*Van Nostrand's Mag.*," xxii. 425.
Military . . . . . * "*Sc. Am. Sup.*," 480.
Piers on, *Smith* . . . . . "*Sc. Am. Sup.*," 310.
Large span Railway . . . . . "*Sc. Am. Sup.*," 2436.
Spar . . . . . * "*Sc. Am. Sup.*," 1128.
Temporary, *Bouilliant*, Fr. . . * "*Sc. Am. Sup.*," 3802.
Metallic arches for tunnels . . * "*Sc. Am.*," xxxviii. 70.
Iron bridge of long span . . . "*Sc. Am.*," xlii. 53.

The following works may be consulted : —

Haupt's "Theory of Bridge Construction."
Fairbairn's "Application of Cast and Wrought Iron to Building Purposes." New York, 1864.
Fairbairn's "Britannia and Conway Tubular Bridges," London, 1349.

McMaster's "Bridge and Tunnel Centers."
Cain's "Maximum Stress in Framed Bridges."
Dempsey's "Tubular and Iron Girder Bridges." (Weale's Series.).
Buck's "Practical and Theoretical Essay on Oblique Bridges."
Buck's "Modern American Bridge Building."
Haskall's "Railway Construction for the East." London.
Haskall's "Examples of Bridge and Viaduct Construction." London.
Humber's "Practical Treatise on Cast and Wrought Iron Bridges and Girders." 58 plates. Imperial 4to.
Humber's "Complete Treatise on Cast and Wrought Iron Bridge Construction." 2 vols. 4to. London, 1870.
Humber's "Record of the Progress of Modern Engineering." 4to.
Bender's "Proportions of Pins used in Bridges."
Bender's "Continuous Bridges." New York, 1876.
Merrill's "Iron Truss Bridges." New York, 1875.
Shreve "On Bridges and Roofs." New York, 1873.
Whipple "On Bridge Building." New York, 1873.
Roebling's "Bridges." New York, 1869.
Chanute's "Kansas City Bridge." New York, 1870.
Jenken's "Bridges, Treatise on Construction of." Edinburgh, 1878.
Collum's "Military Bridges."
Haupt's "Military Bridges." New York, 1864.
Pope's "Treatise on Bridge Architecture." 1811.
Gaudard's "De divers Systèmes de Ponts en Fer." Paris, 1855.
Baker's "On Long-span Railway Bridges." Philadelphia, 1867.
Boller's "Iron Highway Bridges." New York, 1876.
Unwin's "Wrought Iron Bridges and Roofs." 1869.
Woods's "Construction of Bridges and Roofs." New York, 1876.
Conrotte's "Les Pont de l'Amerique du Nord." Paris, 1878.

2. A plank to cover the gap between the platforms of two connected cars.

Bridge, safety, *Frazer* . . * "*Scientific American*," xxxv. 5.

3. An arrangement for measuring the resistance of an element in the circuit, Fig. 1840, p. 779, "*Mech. Dict.*"

Meter resistance, *Hockin* . . . * "*Teleg. Journal*," v. 239.
Wheatstone . . * "*Teleg. Journal*," v. 288.

Bridge Guard. A suspended system of ropes used to warn train-men of bridges which are not high enough to permit them to stand on top of the cars. To a horizontal arm which projects over the track wires are attached, and to these pieces of rope. The height from the top of the car to the lower end of the wires is sufficient to allow a man to stand upright, but if he does so in passing under the guard he is struck by the ropes, which warn him that the train is approaching the bridge, which without such warning he might strike.

"*Railroad Gazette*" . . . . . * xxiv. 627.

Bridge'pot. (*Milling.*) The socket of the mill spindle carried by the lighter-screw which adjusts the vertical height of the runner to grind close or coarse.

Fig. 425.

Arch Bridgepot.

The arch bridgepot, shown in Fig. 425, is intended to be used for straddling the driving-shaft where bevel-gear is used. On bridgepots used in portable mills the fulcrum is so arranged as to allow of placing the lighter-screw to the right or left of the meal spout at will.

Bridge Sad'dle. The block which rests upon the summit of the pier of a suspension bridge, and over which the wires pass, and upon which they rest. See Fig. 4519, p. 2011, "*Mech. Dict.*"

Bridge Test'ing Car. A car with a tank capable of being loaded to the required strain *in situ.*

A car said to be owned by the State of Connecticut, and used in testing railway bridges, is thus described: —

"The car is to be used on every railroad bridge in the State at least twice a year. It consists of an iron tank resting upon three trucks, the tank being capable of holding eighty tons of water. On the center truck are four hydraulic jacks, operated by one lever, and by these the entire weight of car and contents can be thrown upon the center truck. In case a weakness is discovered, the floodgates are opened by a single lever and the water instantly let off, relieving the bridge of 80 tons weight. The car will weigh about 60 tons, and when the 80 tons of water are added, the full test will be 140 tons. This weight may be lessened, of course, if desired."— *Chicago Railway Review.*

Brim-poun'cing Ma-chine'. A machine for shaving hat brims, to remove the shaggy fibres. See Pouncing Machine.

Brim Stretch'er. A machine for stretching the brims of felt hats, developing them out of the edge of the crude cone. See Fig. 427.

The brim-stretching ribs which support the brim are mounted upon a vertically reciprocating spindle which is operated by the treadle, and these ribs are provided with a spreading mechanism and are operated by the hand lever on the side of the machine. An adjustable metallic block supports the crown, and by its position determines the height of it. The upper stretching devices consist of a series of automatically reciprocating brim-stretching ribs, arrayed in a horizontal plane, equidistant from each other, in a circular line; each operating from a common center in a different vertical plane. A crank-shaft which has its bearings in the framing receives motion through the belt from a counter-shaft, and should make 500 revolutions per minute.

Through the connecting rod a reciprocating motion is given to the rocking shaft and the rods which carry the ring to which the outer ends of the vibrating stretching ribs are attached.

The hat body to be stretched, having previously been drawn out on the tip by a *tip-stretcher*, is placed upon the former of this machine and the treadle depressed, bringing the two sets of stretching ribs in working position. The hand lever is now gradually raised, and the hat-body thus spread to cause the vibratory ribs to act upon it.

When the hand lever has been raised sufficiently high to bring the spreading ribs to their full extension, the former is lowered, the hat-body shifted slightly upon it and the operation repeated until the brim is perfectly flattened out.

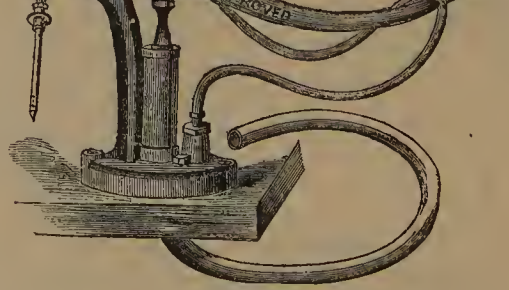
The rapid motion of the vibrating ribs enables the operator to stretch the hat while it is hot and injury by tearing is thereby prevented.

Machines made on the same principle for use in factories where all the work is done by hand are now very generally used, and but a very small percentage of all the soft wool and fur hats are now blocked in the old manner.

The finishing of fur hats is done upon a fur hat blocking machine which has an oval former, and acts upon the crown and brim simultaneously. See Hat-shaping Machine.

Brine-for'cing Pump. A pump for injecting brine around the bone of hams and shoulders to insure the curing.

Fig. 426.

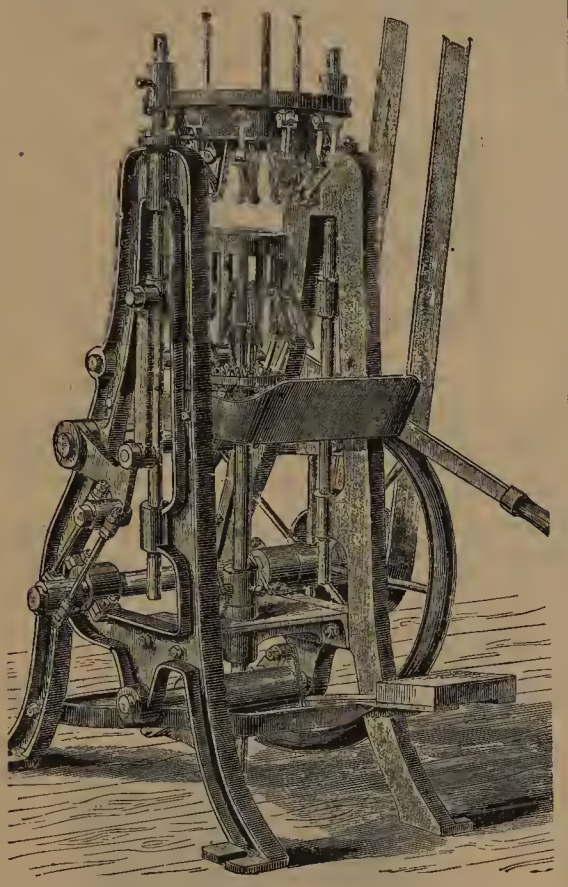


Ham Pump.

Bri-quet'. Fuel compressed into brick-like blocks. A product of increasing economic value, composed chiefly of inferior coal or coal waste, to which is added coal-tar as a cement.

France, Belgium, Germany, and even Great Britain manufacture this new fuel, France obtaining part of her supply of the raw material from Wales, and finding a market for the sale of a portion of the manufactured product in Italy, where it is used as fuel for locomotives. Machines for the manufacture of this fuel are numerous, and several forms are shown under PEAT MACHINE, p. 1646, "*Mech. Dict.*" France annually produces about 700,000 tons of briquets and Belgium about 500,000 tons; Germany and Great Britain, respectively, manufacture large quantities. At present the use in Europe is mainly upon steamships and in locomotives. In the United States a successful attempt to manufacture compressed fuel from anthracite coal dust has been made on a large scale at Fort Ewen, near Rondout, N. Y., and to-day the enterprise is firmly established, the fuel, which is in large lumps, being supplied to steamships and locomotives. Loiseau's apparatus has attracted and deserved marked attention.

Fig. 427.



Eickemeyer's Power Hat Brim Stretcher.

Two large manufactories of patent fuel are running in Wales, one the Crown Preserved Coal Company, of Cardiff, under the H. Walker Wood Patent, having a capacity for 500,000 tons annually. The process has been worked there since 1857.

Another, the Coal Company of Merthyr, Swansea, producing 200,000 tons annually. The composition is small coal and coal-tar pitch. The process has been carried on there for twenty years.

See FUEL, ARTIFICIAL, p. 921, "*Mech. Dict.*," *et infra.*
Marseilles. *Engineering*," xxvi. 367.

Bris'tle Pro'bang. (*Surgical.*) A probang having on a section of its length a number of bristles arranged lengthwise, so as to catch over and include fungoid or other matters, and furnish a means for the withdrawal of the same. There are several forms, either a bunch of bristles tied at each end, or a frame upon which cords are strained so as to form a sort of cage.

Fig. 336, p. 83, Part II., and page 5, Supplement, *Tiemann's "Armamentarium Chirurgicum."*

Brit'ish Gum. Torrefied starch; used in calico manufacture. Dextrine. See p. 691, "*Mech. Dict.*"

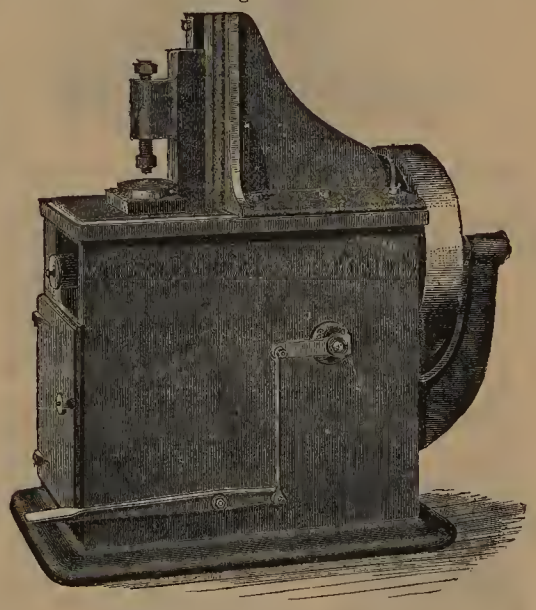
Broach. A reamer, for rounding or enlarging a drilled bore.

Broach'ing Press. A machine designed to make holes by the planing action of a vertically moving tool; especially useful in making holes of such diametrical form that they cannot be finished by any rotary motion, as by drilling or boring. It may be used as a slotter, and also for finishing the outside of work. The pitman which carries the slide is attached to a worm-wheel that runs in a pan of oil; a heavy balance-wheel and the Pratt friction-clutch furnish the means for a steady equable motion, and for stopping and starting instantly at any point of the stroke, which is from 1″ to 7″.

Fig. 428

Broaches, for Rock-drilling

Fig. 429.



Broaching Press. (*Pratt & Whitney.*)

Broad'cast. (*Printing.*) Matter set up to run the long way of a page, and having its top along the left-hand edge.

Broad'cast Seed'er. A machine for scattering seed upon the ground, as distinguished from one which sows it in drills.

Broadcast seeders are power and hand, and each of those kinds has as representatives two varieties: those which scatter widely, imitating the human hand in throwing, and those which sow a breadth equal to the width of the implement.

Of the power machines: The Cahoon machine acts upon a scattering principle. The seed hopper is carried in a wagon and discharges on to a wheel rotated by chain connection from a sprocket wheel on the hind-wheel axles. The rotation of the scatterer disperses the seed widely, from 16 to 36 feet in total width, according to the seed; timothy and wheat being at the opposite ends of the scale. The scattering wheel revolves in a vertical plane.

In Buist & Alden's machine the wheel is horizontal.

In the hand form of the scattering kind, the Cahoon drill consists of a bag carried in front by a neck strap, and a scattering wheel rotated by hand.

In a French form of the same implement, shown in Fig. 430, and made by Pernollet, of Paris, the scattering wheel is vertical as in the Cahoon, and the width of wheat sown is 7 to 8 meters.

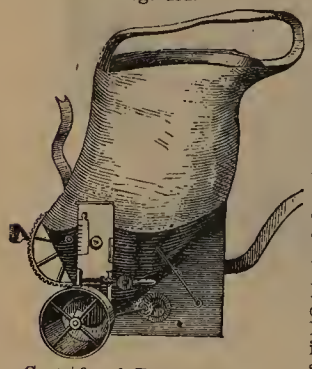
Fig. 431 shows on a larger scale the apparatus detached

Fig. 430.

Sowing with the Pornollet's Centrifugal Broadcast Sower.

from the person. An index on the side shows the condition of the opening which graduates the passage of seed according to the quantity desired to be sown.

Fig. 431.



Centrifugal Broadcast Sower.

In regard to machines for sowing widths equal to the track machines, such are both power and hand.

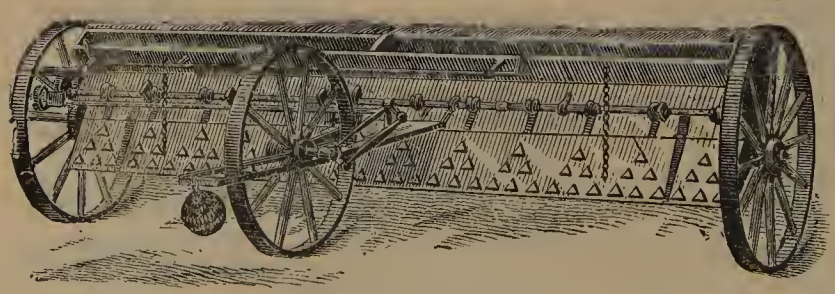
Of the power machines there are at least three varieties: —

The convertible drill, in which the shares and seed tubes are replaced by spouts which scatter the seed upon the surface of the ground, each of the eight spouts covering with seed its proportionate width of the track of the machine. Many of the American seed drills are thus convertible. In France the same practice is pursued, a broad casting spout of sheet metal being substituted for the seed-conductor. See Fig. 124, p. 113, Knight's report, "*Paris Exposition Reports*," vol. iv.

Another form of broadcaster is represented by the "Buckeye" 11-foot broad-cast sower. This has a force-feed at each of 7 openings, and has conductors which lead the seed near to the surface of the soil: but, instead of dropping it in the rear of the shares, — none of which are present, — the seed drops on a scattering plate from which it bounces on to the ground.

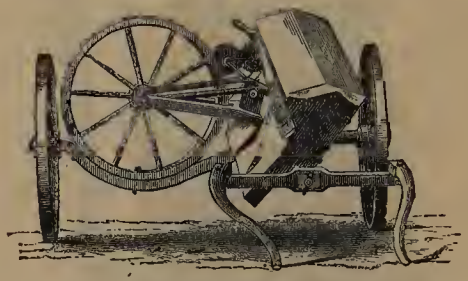
A third form of the machine broadcaster is that common in England and on the Continent of Europe. The seed, issuing from the series of spouts, falls down an inclined board, whose length is equal to the width of the bout, and, striking against triangular studs, arranged in quincunx fashion, is dispersed over the whole space of ground between the wheels of the machine. The machine illustrated, Fig. 432, is Danish, made by Ramussen & Co., of Stubbekjobing, but resembles in all material respects that made by Smyth & Sons, of Peasenhall, England. The Danish machine, however, is so constructed as to be capable of being whirled around so as to travel upon a cross-axle, in order to allow it to pass along narrow roads and through gateways. The motion of the seed-distributor is obtained from the rear wheel, seen in Fig. 432, on the ground, and in Fig. 433, as mounted on the cross-axle.

Fig. 432.



Ramussen's Broadcast Seeder.

Fig. 433.



Ramussen's Broadcast Seeder on its Cross-axle.

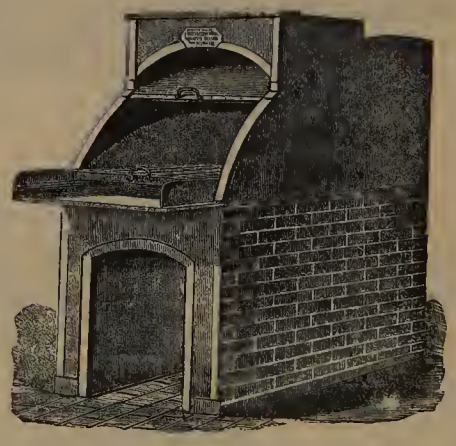
Broad'-tread Wheel. (*Railway.*) A wheel with an extra-wide tread to enable it to travel safely, varying within a range of say $1\frac{1}{2}''$ difference of gage.

Also known as a *compromise* wheel.

Broil'er. 1. A gridiron.

2. A hearth for broiling steaks, etc., on a large scale. It is heated with charcoal, has a gridiron sliding on ways, a canopy to conduct the fumes to the chimney, a pit beneath for draft and ashes, and a sliding cover, to contract at pleasure the open space above the gridiron.

Fig. 434.



Charcoal Broiler.

Brok'en Ash'lar. (*Masonry.*) A form of cut-stone work in which the continuity of courses is not maintained. See ASHLAR.

Brok'en Range Work. (*Masonry.*) A form in which the level of courses is not strictly maintained. See RANGE.

Bro'mine Ap'pa-ra'tus. The source of bromine in the United States is the mother liquor which

remains after the extraction of salt. The following description of the process is condensed from the "*Moniteur Scientifique*": —

"The saline liquors, when first pumped up from the pit, mark 9° Baumé. They are evaporated in long iron boilers to 15° Baumé, allowed to settle, then farther evaporated to the crystallizing point in wooden tubs heated by steam. The first crystallization forms the salt of commerce. The tubs, five in number, are placed side by side, and every day the liquor is decanted from one to another, — from No. 1 to No. 2, then to No. 3, and so on to No. 5. The crystallized salt is removed from each tub after draining off the liquid. When the brine reaches tub No. 5 it has become mother liquor, and consists principally of chlorides of calcium, magnesium, sodium, and a little chloride of aluminium, with varying proportions of bromides of sodium and calcium. Tub No. 1 is filled every day with fresh brine, so that the process becomes continuous. The mother liquor, marking 30° to 38° Baumé, is evaporated to 45°, thus separating a new quantity of salt. The liquor is then decanted into stone stills; materials for the production of chlorine are added; and heat is applied in the form of steam injected directly into the still, until all the bromine has been eliminated and evaporized. It then passes into a condenser, and thence into a receiver."

See —

"*Scientific American*," xli. 240.

Dr. Jenkins' report in "*Paris Exposition Reports*," 1878, iv. 54, 55.

Bromide of Ethyl Apparatus, "*Manufacturer & Builder*," xii. 157.

U. S. BROMINE PATENTS.

No.	Inventor.	No.	Inventor.
5,658.	Alter & Gillespie.	110,662.	J. J. Jühler.
12,077.	E. Stieren.	132,296.	Leruer & Harpold.
62,464.	D. Alter.	137,222.	Leyert & Winter.
62,988.	D. Alter.	137,512.	D. C. Turner.
82,309.	G. A. Hageman.	181,617.	F. W. Arvine.
93,099.	H. Leruer.	217,076.	J. N. J. Dubreuil.
103,253.	Stieren & Nesbet.	219,004.	Müller & Böckel.

Bronze. An alloy of copper and tin: the most ancient artificial alloy.

The molds for casting bronze articles are found in many European countries, as are also pieces of runners and sprues made in running the metal into the mold. In general, the proportions are 90 copper, 10 tin; but tables in *Wilson's* "*Prehistoric Man*," pp. 310, 312, and vol. i., p. 388, of the "*Mechanical Dictionary*," indicate various proportions and additions, in many cases, doubtless, unsuspected impurities.

The addition of a small quantity of iron, insisted upon of late as so valuable in the constitution of brasses and bronzes is seen by table on p. 61, "*Mech. Dict.*," to have been anticipated in the ancient bronze weapons of England and Ireland, the coins of Rome, weapons of South America, and the Chinese *packfong*.

Herrera specifies "crucibles to melt copper," as contained in the canoe met near one of the Guanaja islands, manned by a Yucatan cacique, his wives, children, and 25 rowers.

See also *Worsaal*, "*Primeval Antiquities of Denmark*," pp. 137, 138.

In addition to the compositions given on pp. 387-389, "*Mech. Dict.*," the following may be noted. Patents of —

Doubleday, No. 160,885. Copper, glass, antimony, tin, spelter, and lead.

Kirk, No. 201,536. Copper, tin, arsenic.

AUSTRIAN STATE RAILWAY BRONZES AND BRASS.

	Copper.	Tin.	Zinc.
For locomotive bearings, slide valves, valves, etc.	84	16	–
For coach and car bearings	85	15	–
For cocks	90	10	–
For boiler tubes	70	–	30

Article on casting of bronze figures in built molds; *cire perdue*; zinc molded in copper molds (imitation or French bronze); with the subsequent finishing and mounting, from the "*N. Y. Tribune*." — "*Sc. Am. Sup.*," 1601.

Various alloys known as bronzes are considered under the following heads; though many are not true bronzes (copper-tin), being destitute of tin. The word "bronze" is a favorite, and, though promiscuously applied, protest is useless.

See: —

Aluminium bronze.	Inlaying bronze.
Antique bronzing.	Japanese bronzes.
Bismuth bronze.	Malleable brouze.
Bronze blacking.	Manganese bronze.
Bronze coloring.	Manganese copper.
Bronzed glass.	Mildew bronze.
Bronze paint.	Nickel bronze.
Bronze steel.	Orugo.
Bronzing.	Patina.
Carbon bronze.	Phosphide of copper.
Cupro-manganese.	Phosphor bronze.
Deoxodized bronze.	Tungsten bronze.
Electro-bronzing.	White brouze.

See also under the following references: —

"*Iron Age*."

For machinery	xxii., Dec. 19, p. 13.
Artistic castings	xx., Nov. 22, p. 24.
Properties of	xxiv., Nov. 27, p. 9; Dec. 4, p. 15; Dec. 11, p. 9; Dec. 18, p. 3.
Malleable	xxv., Feb. 25, p. 26; May 13, p. 17.
Coloring	xxiv., Dec. 25, p. 1.
Casting	xxiv., Dec. 11, p. 16.
Bronzes	xvii., May 4, p. 23.
Antique bronze	xvii., March 23, p. 9.
Electro bronzing	xvii., May 18, p. 16.
Bronzing metals	xxiv., Dec. 18, p. 7.
Bronze stem for corvette, Br.	xix., March 8, p. 15.

"*Manufacturer and Builder*."

Colored	x. 264.
Blue	viii. 263.
Ornaments	xi. 235.
Japanese	xi. 83.
Patina	xii. 263.
Bronzing iron	xii. 204.

"*Mining and Scientific Press*."

For valves	xxxv. 147.
Alloys	xxxvii. 39.
French imitation	xxxvii. 358.
For machinery	xxxviii. 19.
Malleable	xl. 135.

"*Scientific American*."

Experiments	*Thurston.*	xxxvii. 65.
Japanese	*	xxxv. 255; xl. 249; xxiv. 385; xl. 24; xli. 217.
Malleable		xlii. 178.
Cleaning		xxxvi. 203.
Bronze steel & guns	*Uchatius.* *	xxxvii. 403.
Vienna	*	xl. 10.
On bronzes		xl. 122.

"*Scientific American Supplement*."

Finishing		620.
Art-working in	*Vors.*	77.
Japanese		1831, 389, 442.
Composition		3341.
Casting		1601.
French		2690.
Bronze steel	*Uchatius.*	1299.

"*Engineer*."

Bronze steel	*Uchatius.*	xlii. 331; xliv. 254, 310.

"*English Mechanic*."

Cleaning	xxvi. 292; xxvii. 76.

"*Van Nostrand's Magazine*."

Bronze age	*Burnouf.*	xix. 502.

Bronze Black'ing. A concentrated solution of R R B methyl violet in a boiling solution of 4 parts shellac and 1 part of borax, in 15 to 20 of soft water.

Bronze Col'or-ing.

"The *soft bronze* color of medals is obtained by rubbing with a mixture of blood-stone and graphite, applied with a brush.

"*Antique green* effects are reached by dipping the metal into a solution of 10 parts by weight of salt, 10 parts of cream of tartar, 10 parts of acetate of copper, 30 parts of carbonate of soda in 200 parts of vinegar.

"*Satin finish* is produced by green vitriol or copperas and subsequent treatment with wax.

"*Old green* is obtained by several coats of acid and a final coat of wax.

"*Grayish green* is produced by sal-ammoniac." — *M. Grinand*, in Paris "*Technologiste*."

In the Japanese practice, the coloring is done in many different ways, each manufacturer having his own particular process, which he modifies according to the composition of

the alloy and the color he wishes to produce. The chemicals used for this purpose are very few in number, and limited to vinegar, copper sulphate, and verdigris as the principal substances; other materials used less frequently, consist of iron sulphate, red oxide of iron, lacquer, and an infusion of *Eryanthus tinctorius*.

See BRONZING; see also PATINA, ORUGO.

Bronzed Glass. A new kind of ornamental glass, so called from its dark metallic appearance, like old bronze. It is a dark green glass, which has been subjected to corrosive vapors in such a way as to bring out the iris hues and give the appearance of great antiquity. This effect is enhanced by the classical shapes in which the vases are blown, resembling the ancient Roman glass of the museums. Viewed by transmitted light this glass is dark green, like glass colored by oxide of copper.

See IRISATED GLASS.

Bronze Paint.

Recipe: — For iron. Ivory black, 1 oz.
Chrome yellow, 1 oz.
Chrome green, 2 lbs.

Mix with raw linseed oil, adding a little Japan to dry it. It gives a bronze green. Gold bronze may be put on the prominent parts of the object, rubbing on with a piece of plush before the paint is quite dry.

Another: —

To one pint of methylated finish add 4 oz. of shellac and ½ oz benzoin; put the bottle in a warm place, shaking it occasionally. When the gum is dissolved let it stand in a cool place two or three days to settle, then gently pour off the clear mixture into another bottle, cork it well, and keep it for finest work. The sediment left in the first bottle, by adding a sufficient quantity of spirit to make it workable, will do for the first coat or coarser work when strained through a fine cloth. Next take ½ lb. of finely ground bronze green — the shade may be varied by using a little lamp black, red ocher, or yellow ocher; let the iron be clean and smooth, then take as much varnish as may be required, and add the green color in sufficient quantity; slightly warm the article to be bronzed, and with a soft brush lay on it a thin coat. When that is dry, if necessary, lay another coat on, and repeat until well covered. Take a small quantity of the varnish and touch the prominent parts with it; before it is dry, with a dry pencil lay on a small quantity of gold powder, and then varnish the whole.

Bronze Steel. Name given by Uchatius to his gun-metal alloy. The Rosthorn gun-metal, Austrian Navy brass, Parke's British gun-metal, and Overman's bell-metal, contain notable quantities of iron in their composition.

"*Scientific American*," xxxvii. 403.
"*Scientific American Supplement*," 1299.
"*Engineer*," xlii. 331; xliv. 254, 310.

See also list of "*Brasses and Bronzes with the addition of Iron*," table, p. 61, "*Mech. Dict.*"

Bron'zing. Giving the appearance of bronze to a surface by a covering of metallic dust.

The surface, if of metal, is usually covered with oil varnish, and when almost dry the bronze powder is dusted upon it.

BRONZE COLORS.

Real Gold. — Made of scraps of gold leaf, mixed with honey or gum, ground on a tablet, washed and dried. Different shades are obtained by alloying with silver and copper: red, reddish, deep yellow, pale yellow, greenish. Gold powder may also be obtained by dissolving in aqua regia, and drying.

Imitation Gold. — Obtained from the waste of Dutch leaf, triturated in gum, washed and dried. The color depends on the proportions of copper to zinc. Violet and green shades are obtained by heating with oil, paraffine, or wax.

Mosaic Gold. — Tin 64.63, sulphur 35.37; soluble in hydrochloric acid, aqua regia, or boiling caustic potash. Used for bronzing plaster casts, copper, and brass, by mixing with 6 parts bone-ash and rubbing on wet.

Mosaic gold may also be obtained by heating sulphur 6 and tin amalgam 16 with mercury 1 and sulphur 4.

Or, stannic acid 8, sulphur 4.

Or, fuse pure tin 12, mercury 6, to an amalgam, and mix with flowers of sulphur 7, and sal-ammoniac 6. Heat in a retort, and after the vapors escape the mosaic gold will be found at the bottom.

Silver Bronze. — Scraps of silver foil triturated in oil.

Imitation Silver Bronze. — Imitation silver leaf similarly treated.

Mosaic Silver. — Amalgam of tin 50, bismuth 50, and mercury 25. The metals being melted and stirred and the mercury added. When cold, grind with a muller on a stone.

Copper Bronze. — Copper foil rubbed fine and ground.

Bronze Powder or Antique Bronze. — 16 copper and 1 tin beaten into leaves and ground. Bright yellow, copper 83 parts, zinc 17; orange, copper 90 to 95, zinc 5 to 10; copper red, copper 97 to 99, zinc 1 to 3.

Greenish Copper Bronze. — Copper bronze mixed with acetate of copper (verdigris). Imitates the antique *Patina*

Patina Powder. — Bronze treated with different salts: Vinegar, nitrate of copper, sal-ammoniac, oxalate of potash, etc.

Brownish Gold Bronze. — Iron rust mixed with any of the copper bronzes according to color.

Gold-colored Copper Bronze. — Boil together an amalgam of zinc 1, mercury 12, some hydrochloric acid, a solution of tartar crystals, and copper bronze precipitated from the nitrate by iron. The color is varied by shorter or longer boiling.

Or, boil the copper bronze with a solution of 1 part gold in aqua regia; evaporate, dissolve in water 8 parts, and add ½ part ignited magnesia, then boil. The precipitate of oxide of gold is filtered, placed in a flask, and 8 parts cyanide of potassium poured over it.

Blue Bronze. — White bronzes colored with aniline blue.

SUBSTITUTES FOR BRONZING.

Tungsten Bronze. — Tungstate of soda and tungsten forming gold-yellow crystals; magenta or violet bronze, a tungstate of tungsten and potash.

Chromium Bronze, or violet chromium chloride.

Titanium Bronze, Crystallized Iodide of Lead, etc.

Coal Tar Bronzes, such as acetate of rosaniline, murexine, and green hydrochinon.

Mica Bronze. — Mica pounded into fine flakes, assorted in fineness and dusted on to a prepared or varnished surface. Colored, —

Pink, by cochineal.
Carmoisin, by bluish fuchsia.
Violet, by Hofmann's violet.
Blue, by prussian blue.
Violet-blue, by logwood.
Green, in shades, by turmeric and aniline blue.
Golden, by turmeric.
Silver, pure mica.
Black, by logwood and litmus.

A ground of proper color must first be laid on, and the mica powder dusted on before the ground is quite dry. Excess of mica is brushed off.

For Cast Iron, without the use of metal or alloy. — The article is cleansed, coated with a uniform film of some vegetable oil, and then is exposed in a furnace to the action of a high temperature, which, however, must not be strong enough to carbonize the oil. In this way the cast iron absorbs oxygen at the moment the oil is decomposed, and there is formed at the surface a thin coat of brown oxide, which adheres very strongly to the metal, and will admit of a high polish, giving it quite the appearance of fine bronze.

Process for producing a Green Bronze on Iron. — One part of sylvate of silver is dissolved in twenty parts of oil of lavender, forming a sort of varnish, which imparts a beautiful and permanent green bronze appearance to cast and wrought iron, sheet iron, and wire. The surface to be bronzed is cleansed and dried, but need not be polished. The varnish is thinly applied with a camel's-hair brush, and the object heated quickly to 300° Fah. The proper temperature is indicated when the article shows an even bright green color. — *Paul Weiskopf in "Dingler's Journal."*

For Cast Iron. — Coat the surface of the iron (cleaned by acid and well etched) with ferrocyanide of copper, applied with linseed oil. Before this coating is entirely dry, apply bronze powder by means of a fine brush, and then polish with a burnisher. When the surface is entirely dry, wash and etch to the color desired. The use of the alkaline sulphides for the etching produces olive-green and black colors, which closely resemble those on the Japanese bronzes.

For Rifle Barrels, to Prevent Rusting. — A modification of the Barff process. Pass the current of air slowly and at a high temperature over the articles to be covered, care being taken to secure an entirely free circulation about the articles. Articles exposed for five hours at a temperature of 536° Fah., resisted the action of emery paper and dilute sulphuric acid.

See various recipes and processes, p. 389, "*Mech. Dict.*"
See, also, BRONZE PAINT.

For giving Bronze Color to articles of Copper, Brass, or Zinc. — *Roncou's* process: Treat with a composition of —

Sulphate of potassium	6
A salt of lead	6
Ammonia	12
Acetic acid	3
Hydrochloric acid	3

Antique Imitation. — Apply alternate washes of dilute acetic acid and exposure to the fumes of ammonia.

A quicker method: Immerse the articles in a solution of

1 part perchloride of iron in 2 parts of water. The tone assumed darkens with the length of immersion.

Or the articles may be boiled in a strong solution of nitrate of copper.

Or they may be immersed in a solution of 2 ozs. nitrate of iron and 2 ozs. hyposulphite of soda in 1 pint water. Washing, drying, and burnishing complete the process.

Chinese Process of Bronzing Copper.

The following ingredients are pulverized and mixed: —

Verdigris	2
Cinnabar	2
Sal Ammoniac	5
Alum	5
Beak and liver of duck	2 (!)

Make into a paste with vinegar and spread over the scraped surface of the copper. The object is exposed an instant to the fire, cooled, and the operation repeated until the required tint is attained. Addition of sulphate of copper gives a browner tint, and borax a yellower shade. The color is durable and not affected by air or rain.

Bronzing Wood, Leather, Paper, etc.: Dissolve gum lac in four parts by volume of pure alcohol, and then add bronze or any other metal powder in the proportion of one part to three parts of the solution. The surface to be covered must be very smooth. In the case of wood, one or several coats of Mendon or Spanish white are given, and the object is polished with an iron of proper shape. The mixture is painted on, and when a sufficient number of coats have been given, the object is well rubbed; the coating obtained is not dull, but can be burnished. A transparent varnish is applied to preserve the metallic appearance thus obtained.

Soluble Glass in Bronzing. — "*Bottger* varnishes objects of wood, porcelain, glass, or metal with soluble glass, and then shakes bronze powder over them." — *Dingler's Journal.*

Plaster Casts. — The casts receive first several coats of a rapidly drying linseed oil varnish. When the surface has been thickly and evenly covered, and the varnish is completely hardened, another coat is given with a varnish composed as follows: Linseed oil varnish, 1 part; copal varnish, 1 part; oil of turpentine, 1-15 part. The copal varnish must be free from alcohol. This varnish will be dry enough in from 18 to 24 hours; the coat must be quite glossy and adhere slightly to the fingers. Powdered gold, silver, or copper bronze is now applied with a soft brush. The surface is then rubbed with cotton wadding, by which a very beautiful finish is imparted to it. The most important point is that the linseed oil varnish is perfectly dry before the other varnish is applied, and the latter must be of the proper consisteuce before bronzing it. — *Chem. Zeitung.*

See the following references: —

"*Iron Age.*"

Antique	xvii., Mar. 23, p. 9; xxi., Juue 6, p. 19.
Cast-iron	xxi., March 7, p. 1.
Electro-bronzing	xxii., Dec. 5, pp. 3, 18; xxiii., Feb. 6, p. 17.
On wood, paper, etc.	xxiii., March 13, p. 17.
On metals	xxiv., Dec. 18, p. 17.

"*American Manufacturer and Iron World.*"

On metals	xxv., Dec. 26, p. 12.

"*Van Nostrand's Engineering Magazine.*"

On iron	xviii. 103.

"*Mining and Scientific Press.*"

On iron	xxxvi. 3.
On leather, paper, etc.	xxxviii. 215.
Bronze green	xxxviii. 319.
Plaster statues	xxxviii. 231.

"*Manufacturer and Builder.*"

On leather	ix. 77.
Antique	x. 148.
On iron	xi. 96; xii. 204.
Plaster statues	xi. 24.
Bronze varnish	xi. 120, 287.

"*Engineering & Mining Journal.*"

Soluble glass in	xxvii. 204.

"*Scientific American.*"

Iron	xxxiv. 243; xxxv. 76.
Paint	xxxiv. 312; xxxvii. 118.
Plaster casts	xl. 122.
Compound	xxxvi. 87.
Powder	xxxiv. 243; xxxvii. 363; xxxviii. 28
Aniline	xxxvii. 213.
Liquid	xxxix. 75.
Size for	xli. 331.

"*Scientific American Supplement.*"

On iron	3748, 1510.	On plaster casts	2686.
On feathers	2591.	Electro	2610.

"*English Mechanic.*"

On plaster casts	xxv. 470, 494; xxvi. 342; xxvii. 533.
Florentine	xxv. 189.
Dull black	xxvii. 659.
Powders	xxv. 341, 367; xxvi. 463, 487.
On brass	xxvi. 368, 389.
On zinc	xxv. 470, 494.
Relacquering	xxvii. 274, 425.
On copper	xxiii. 527.
Antique	xxvii. 177.
Fluid aniline bronze	xxiv. 309.

"*Engineer.*"

Castings	xlvi. 431.

Bron'zing Ma-chine'. A machine for applying bronze-powder to paper, foil, or cloth previously printed with size. See United States Patents, Nos. 161, 734; 175,450.

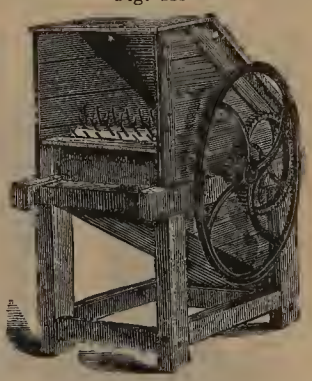
In addition to what has been said and shown on pp. 389, 390, "*Mech. Dict.*," the French method may be consulted in the article "*Poudreuse ou Bronzeuse Mecanique*," * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877.

Brood'er. A chicken protector. In some cases a coop of remarkable neatness and extent.

Again: a protector with artificial warmth, on the principle of the incubator, but allowing ingress and egress. See, also, ARTIFICIAL MOTHER.

Broom'-corn Scra'per. A rotary toothed cylinder is operated through its multiplying gearing by either hand or power, and is used for clearing broom-corn brush of its seed.

Fig. 435.



Cylinder Broom-corn Scraper.

The *ripple* has been used for 4,000 years in Egypt in removing the seed of *dhura* from the stalk, and is yet used in hand processes with flax. See Fig. 4341, p. 1946, "*Mech. Dict.*"

Broom'-corn Siz'er. A machine for sizing or preparing the corn to regular lengths, for the various sizes of brooms as required.

Broom Ma-chin'e-ry.

UNITED STATES PATENTS.

Broom-making machines.	
Clamp, *Day*	69,780
Day	59,977
Day, reissue	2,495
Cutting and assorting machine, *Bradley*	80,443
Sizing machine, *Truair*	33,968
Sorting machine, *Grosvenor*	7,892
Cutting and separating machine, *Walrath & Snell*	131,138
Sizing machine, *Walrath*	165,458
Blood & Topping	166,065
Handle socket, *Anderson & Houghton*	156,324
Rowe	18,770
Anderson & Houghton	150,669
Anderson & Houghton, reissue	6,275
Warner	5,444
Lyon & Hopkins	62,548
Beaman	3,219
Allen	167,051
Hinton	3,483
Spooner	718
Sherman	38,341
Split brooms, *Crum & Lanyill*	6,233
Walker	11,451
Needle, *Cowardin*	119,745
Press, *Thomas*	6,717
Boyer	162,997
Sewing machine, *Stackpole*	91,784
Tying machine, *Congdon*	118,845
Winding machine, *Walrath & Bronson*	168,814

Broom Sew'ing Ma-chine'. A species of vise, with clamping jaws operated by a screw so as to firmly hold the broom while it is being sewed.

Broom Trim'mer. A rack with a bevel-slot-

ted aperture, on the end of the rear post that surmounts the table, and holds the broom with the assistance of the adjustable clamp on the table, while the pivoted knife trims it off.

Fig. 436.

Broom Trimmer.

Broom Vise. A clamp in which the round bunch of corn brush is flattened and held while being sewn.

They are made to work with levers or with screws. Fig. 437 shows the former.

Fig. 437.

Broom Vise.

Fig. 438.

Broom Winder.

Broom Wind'er. A machine for winding corn brush, and tying it with cord or wire into a round bunch preparatory to flattening it in the vise and sewing. Fig. 438.

Broth'er-hood En'gine. A popular form in Britain of a THREE-CYLINDER ENGINE, which see. See, also, DYNAMO-ELECTRIC ENGINE, *infra*.

Brown'ing. To confer a brown tint on iron or steel, dissolve in —

Water	4 parts.
Crystallized chloride of iron	2 parts.
Chloride of antimony	2 parts.
Gallic Acid	1 part.

Apply the solution with a sponge or cloth to the article and dry it in the air. Repeat this any number of times, according to the depth of color which it is desired to produce. Wash with water and dry, and, finally, rub the articles over with boiled linseed oil. The metal thus receives a brown tint and resists moisture. The chloride of antimony should be as little acid as possible.

Bruis'ing. (*Leather.*) Doubling the grain side of a hide together, and rubbing it on the flesh with a graining-board.

Brush. Machines for making brushes have been adapted to manufacture certain kinds The majority of kinds are hand-made. See pp. 392–394, *"Mech. Dict."*

Brush binder, for clamping the bristles to the handle, *Blair*, * "*Scientific American*, xxxiv. 118.

Brush machine.

Woodbury, * "*Manufacturer & Builder*," x. 198.

Woodbury, * "*Vienna Exposition* (1872) *Report*," vol. iii., p. 309.

Woodbury, * "*Scientific American*," xxxviii. 351.

In the making of artists' brushes the following bristles and hair are employed: —

Hogs' bristles, varnishing brushes.
Bears' fur, varnishing brushes.
Badger hair, graining and gilding brushes.
Sable tail hair, fiuest artists' brushes.
Camels' hair, second only to the sable.
Ox hair (from the insides of the ears), striping and lettering brushes.

Ashworth's brush-comb, for the hair or the manége, has steel wires attached to an elastic caoutchouc membrane on the handle.

Brush Dike. A device for causing deposits to take place, and for deflecting the current in localities that are to be built out.

The floating brush dike is made by taking saplings from 20′ to 30′ long and from 4″ to 6 or 8″ in diameter, and nailing, or fastening to them with wire, scraggy brush of any kind obtainable in the locality. This forms what is known as the *weed*. Instead of the saplings rope may be used to hold the brush. To one end of this *weed* is attached an anchor of sufficient weight to hold it in position against the current; to the other a buoy to hold up the downstream end and prevent it from going to the bottom under the pressure of the current against it. These *weeds* are placed from 10 to 20′ apart, thus forming the floating dike.

Their action is to check the current gradually without producing that scouring effect to which the solid dike gives rise. This done, a portion of the material that is rolling along the bottom or being carried down in suspension is deposited, and causes a rise in the bed of the river, which changes its channel to the direction desired.

See DAM; DIKE; FLOATING BRUSH DIKE, etc. See list under HYDRAULIC ENGINEERING.

Brush Hold'er. (*Surgical.*) A staff for a brush for applying medicaments to the larynx, œsophagus, conjunctiva, etc.

Figs. 97, 343, 344, 349, 349 *b*, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Brush'ing Ma-chine'. 1. A machine used to brush up the nap on woolen under-shirts, jackets, drawers, or stockings, and put a good surface on the goods.

It consists of a framing of cast-iron, with two fluted rollers for drawing in the goods, also a pair of wooden rollers clothed with teazles or wire cards, according to the quality of the goods to be operated on. The fluted rollers revolve slowly and take in the goods whilst the covered rollers revolve at a great speed, brushing the goods as they are passed through.

2. Curtis & Marble's machine for dressing and cleaning the surfaces of piece goods, has calendering rolls and dampening box attached. It is arranged with one brush and two card rolls for each side of the goods, and is intended to finish them by once running through. It is entirely covered in, and has a fan-blower arranged underneath to carry off dust and lint.

3. A wheat-cleaning machine. In some cases combined with a smutter, so as to have the scouring quality of the latter with the polishing action of the former.

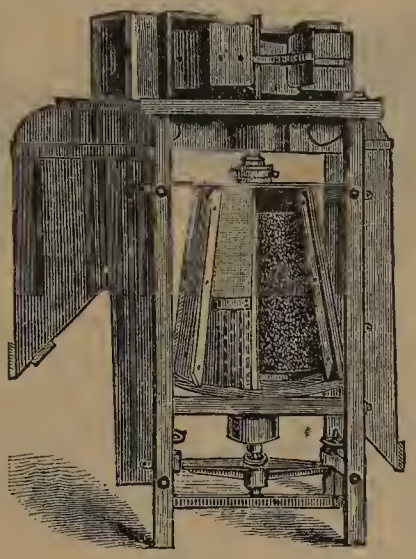
In the Becker brush the concave jacket is of punched iron and steel wire, between which and the brush the wheat passes, polishing and scouring and taking the dust out of the crease, and the fuzz off the end of the berry, without disturbing the bran. The brush may be raised or lowered while in motion. A suction fan removes offal. Fig. 439.

The "Victor" brush has a series of annular inclined trays and brushes, through which the wheat passes in succession. It is known as a *double-brush*, the grain passing moving and stationary brushes, while a blast of air is drawn by an aspirating fan in the reverse direction. Fig. 440.

The brushing is done by a series of concave circular brushes attached to an upright shaft, which act against an opposed series of convex brushes, *c*, which remain fixed to the case. The surfaces of the brushes coalesce when at the closest adjustment, but when at work are separated by a sufficient distance to give passage to the wheat. The grain

falls upon the upper surface of the fixed upper brush, gravitates to the center, and is caught by the upper revolving

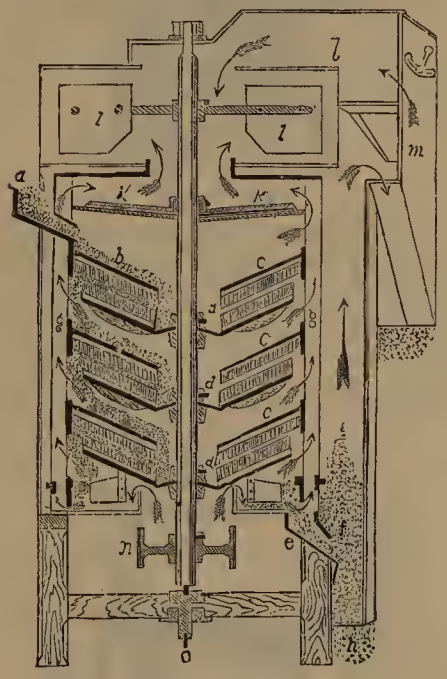
Fig. 439.



Becker Cone-brush.

brush, driven up the incline by centrifugal force, and dropped again to have the same operation twice again re-

Fig. 440.



"Victor" Brush Scourer.

peated. Each set of brushes has an independent ventilator which carries the dust upward to the suction fan, whence it is expelled from the machine.

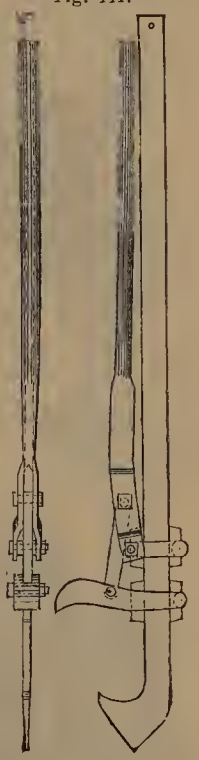
e is the final discharge spout; *n* the driving drum; *g*, ventilator shaft; *k*, cover of brush chamber; *l*, fans and fan-case.

Brush Jack. (*Hydr. Engineering.*) A tool for grasping brush and confining it while being bound into fascines for dikes or dams. The saplings are pinched between two hooks.

It is also used in making mats: the saplings and brush being placed in layers, the hook is thrust through, engaging the lower pole, and the upper hook thrust down, pinching between them a mass of limbs, which are then tied to the pole by the aid of the needle. The handle has two hook-clutches which are slipped over the upper end of the rod, and the upper hook is worked down by using the handle in the manner of a pump-brake. See BRUSH NEEDLE.

Brush Nee'dle. (*Hydr. Engineering.*) A needle for passing a wire around a bunch of brush in a mat. Fig. 442.

Fig. 441.



Brush Jack.

The wire is passed through the eye of the needle-bar and pushed through the mat. A man below removes it, and on the needle being pushed through on the opposite side of the pole replaces the wire in the eye to be drawn back. The wire is cut, the two ends twisted together, and the jack released by prying or hitting the lower or hook clutch on the back end.

Brush Plow. A strong plow, the land side welded to the share, which latter is of hard-rolled untempered steel. Adapted for plowing among roots and brush in new ground. Fig. 443.

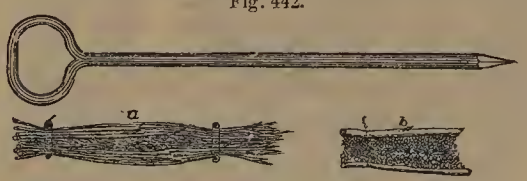
Buck'board. A spring-board wagon, Fig. 444, in which the yielding of the board gives the elasticity to the seat.

In the illustration the buck-board is combined with thorough-brace springs, *F*, *G*, which add to the ease of the rider. Side bars, *B*, connect the front bolster, *A*, with the rear axle. *C C* are side braces.

"*Sc. American*," * xxxviii. 166.

Buck'et. 1. A vessel for holding or lifting water.

Fig. 442.

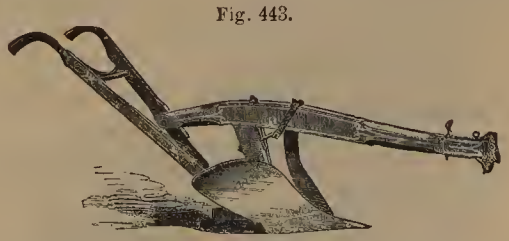


Brush Needle.

2. A valved plunger in a pump-stock.

Bucket plunger pump, *Wright* * "*Engineering*," xxi. 420.
Rubber bucket for chain pumps.
Kenyon . . . . . * "*Sc. American*," xxxvi. 310.
Bucket car, *Darkin* . . . * "*Sc. American*," xxxv. 206.

Fig. 443.



Brush Plow.

Buck'et Lift. (*Mining.*) A set of iron pipes attached to a lifting pump.

Buck'-horn Sight. A fowling-piece sight with a branching horn on each side of the sight-notch.

Fig. 445.

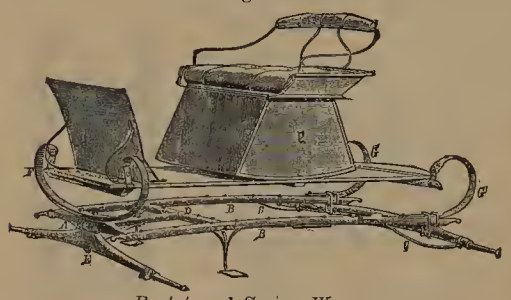
Buck-horn Sight.

Buck'skin Loom. A German pattern-chain loom, with certain peculiarities, and named from the dense and soft character of its product.

"*Zeitschrift für Textil-Industrie.*" Reproduced in "*Scientific American Supplement*," * 2705.

Buck'wheat Hul'ler. A machine for removing the hull of buckwheat before grinding, by

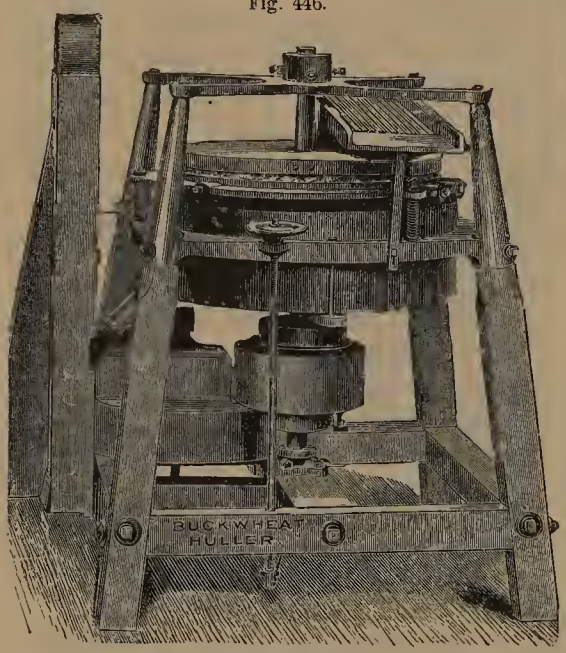
Fig. 444.



Buck-board Spring Wagon.

passing between sandstones, adjusted by tram-studs. The upper stone is stationary, and can be turned over to use either surface and utilize nearly the whole thickness of the stone. A riddle removes foreign matters from the grain before it reaches the stone.

Fig. 446.



Buckwheat Huller.

The machine has a separating trunk and fan by which the hulls are separated from the grain, and the former blown into a refuse trunk.

Cranson's * "*American Miller*" . . . . viii. 336.

Buck'wheat Shuck'er. Another name for the buckwheat huller, which see.

Bud'dle. A species of ore-separating device, using water on an inclined surface. See Fig. 962, p. 398, "*Mech. Dict.*"

Richards's buddle is on the principle of the Barker mill, the water and slime escaping at the ends of hollow arms projecting from a hollow and rotating shaft, and received on a circular table which has a slightly convex surface.

"*Mining and Scientific Press*" . . . * xxxv. 153.

Buf'fer. 1. A block of India-rubber placed on furniture to prevent the defacement of walls by contact of the furniture. A door-stop.

2. A spring block or pad to receive the impact of connected or colliding railway carriages in a train, to absorb the jar.

Fig. 447 is a British form, made by Ibbotson, of Sheffield, England. Other forms are shown on p. 399, "*Mech. Dict.*"

Fig. 447.

Turton's Wrought Iron Spring Buffer.

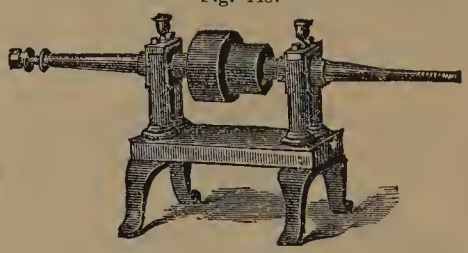
The following references may be consulted: —

Thomas, Br. . . . . * "*Engineer*," xlix. 358.
Tijou, Br. . . . . * "*Engineering*," xxx. 294.
Turton, Br. . . . . * "*Engineering*," xxx. 568.
Garey . . . . . * "*Railroad Gazette*," viii. 87.
London & S. W. Railway . * "*Engineer*," xlvi. 7, 167.

Buf'fing. (*Leather.*) Taking off thin shavings from the grain side with a buffing-slicker until the skin is very thin; the object being to make cowhide imitate calfskin. The operation is finished by whitening.

Buf'fing Lathe. A polishing lathe used by

Fig. 448.

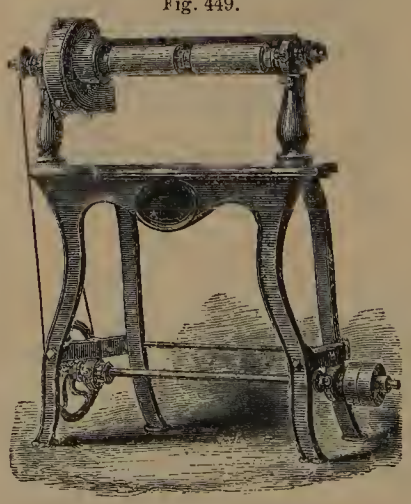


Buffing Lathe.

silver and nickel platers, etc. The buffer of leather, cotton, walrus hide, or other material, is placed on the end of the arbor, which is shown empty, and secured by the screw-nut. The buffer is used with emery, crocus, rouge, rotten stone, putty powder, etc.

Buf'fing Ma-chine'. A machine with a wooden roller covered with sand-paper and used

Fig. 449.



Shoe-sole Buffer.

for buffing shoe-soles, etc. A suction blower runs upon the same shaft and draws the dust into the partially enveloping sheath and discharges it by a duct.

The paper is held by a clamp, dispensing with nails.

Bug'gy Spring.

The Brewster spring has half-springs interposed between the axles and the side bars, and other half-springs between

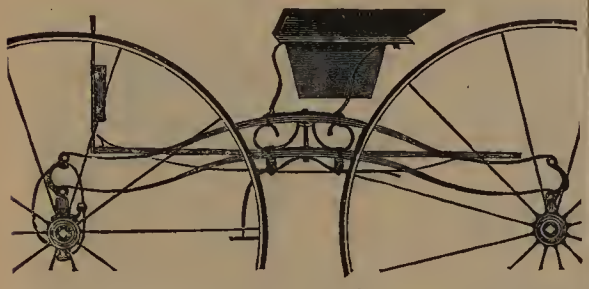
Fig. 450.

Brewster Side-bar Wagon Spring.

the body and side bars, giving the effect of a full elliptic spring, while retaining the modern and stylish appearance of the half-spring wagon. They can be made lighter, hung lower, and are as suitable for country roads as the full elliptic spring wagon.

The "Dexter" spring consists essentially of two "Concord," or side springs on each side; one spring above the

Fig. 451.



"Dexter" Spring.

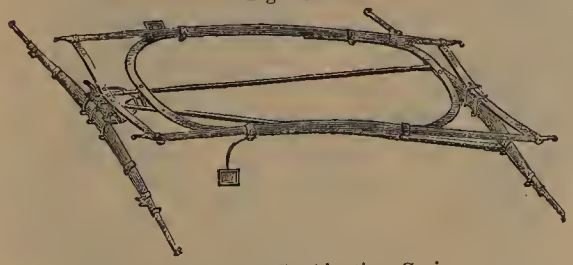
other and parallel to it. The two springs are rigidly connected at their centers, and pivoted at their ends to spring links above or on either side of the axle and spring-bar. The spring-links are rigidly attached to the head block and rear axle respectively.

The parallel motion of the springs prevents rocking of the axles. One spring being above the other prevents side motion and the settling of the body to one side. The absence of a reach allows either wheel to pass over an obstruction almost independently of the other wheels. The elasticity of the springs takes much strain off the fifth wheel, and cushions the stroke when striking an obstruction.

Patents, June 16, September 15, 1874, June 15, 1875.

The Stiver's circular combination spring has a circular

Fig. 452.



Stiver's Circular Combination Spring.

spring used in connection with end half springs, securing the effect of the full elliptic spring.

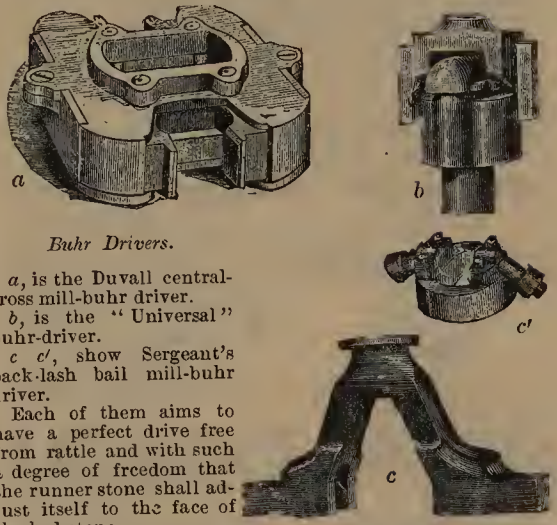
Bu'gle. (*Add.*) The simple bugle or clarion is written on the G clef like the trumpet. It possesses 8 notes. There are bugles in B♭, C, and in E♭. The keyed bugle has 7 keys which traverse chromatically a compass of more than two octaves from B♯ beneath the stave up to C above. The bugle with *pistons* or with cylinders has a lower compass than the keyed.

Buhr Dress'er. An implement for channeling and facing millstones. See MILLSTONE DRESSER; FURROWING AND FACING MACHINE.

Buhr Dri'ver. The stud or projection on the millstone spindle which acts upon the bail of the millstone to drive the latter. The ordinary device is shown at G, Plate XXII., "*Mech. Dict.*," article "*Grinding Mill.*" The bail is also called a balance-rynd.

Fig. 453 shows several forms of drivers.

Fig. 453.



Buhr Drivers.

a, is the Duvall central-cross mill-buhr driver.

b, is the "Universal" buhr-driver.

c c', show Sergeant's back-lash bail mill-buhr driver.

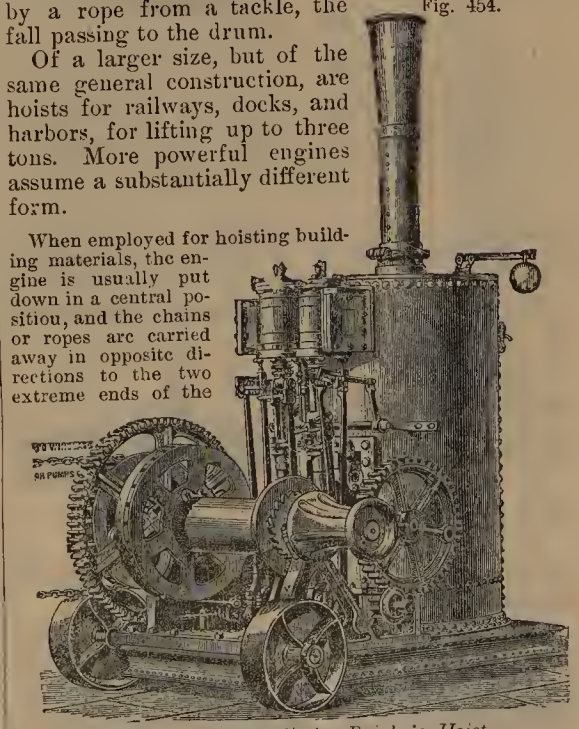
Each of them aims to have a perfect drive free from rattle and with such a degree of freedom that the runner stone shall adjust itself to the face of the bed-stone.

See "*American Miller*," * vii. 300, and elsewhere.

Buhr Rub'ber. A block composed of emery and a cement; used in cleaning, sharpening, and facing down buhrs. *Millstone levelers*, *Furrow dressers*, are synonyms or analogous devices.

Build'er's Hoist. A form of steam-hoist used in lifting stone, brick, mortar, lumber, etc., in constructing buildings. The cage, the barrow, or the material, as the case may require, is suspended by a rope from a tackle, the fall passing to the drum.

Fig. 454.



Of a larger size, but of the same general construction, are hoists for railways, docks, and harbors, for lifting up to three tons. More powerful engines assume a substantially different form.

When employed for hoisting building materials, the engine is usually put down in a central position, and the chains or ropes are carried away in opposite directions to the two extreme ends of the

Appleby's Double-cylinder Builder's Hoist.

works, and there hoist the bricks, mortar, etc., in barrows on to the scaffolds, along which they are wheeled to serve the bricklayers.

The hoists are usually made with two speeds: one for ordinary building work, and a slow speed for hoisting columns and girders, timbers, stones, etc. The weight lifted direct from the barrel is about 1,500 pounds, and for heavier loads blocks and falls are used. The size employed for lifting harrows is 3-horse power nominal, but they are made up to 12-horse power, and with single or double cylinders. Fig. 454. The ends of the shafts are extended, so that a capstan, a pump arm or pulley may be fitted for transmitting power for other purposes, and each engine has reversing gear and all the usual appliances.

Build'er's Knot. A form of knot shown at 27, Fig. 2777, p. 1240, "*Mech. Dict.*"

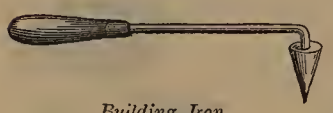
Build'ing Block. Material shaped into blocks for building. See

Clayton	* "*Scientific Amer.*," xxxv. 242.
Hollow concrete . . .	"*Scientific Amer.*," xxxv. 406.
Stone, marble, cement, etc.	"*Scientific Amer. Sup.*," 2020.

See also BÉTON; CONCRETE; STONE, ARTIFICIAL, etc.

Build'ing Iron. (*Electrotyping.*) A heated iron applied to a strip of wax to cause it to flow down from the point on to the blank of the model in order to make corresponding depressions in the plate in the larger spaces where there is no type.

Fig. 455.

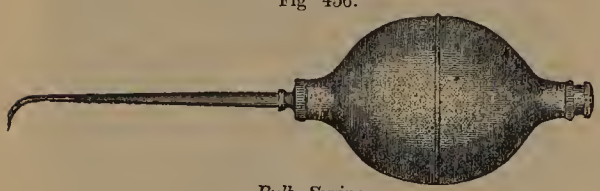


Building Iron.

Build'ing Wax. Wax used in building up the blanks in the molds for electrotype plates. It is cut in strips 8″ to 10″ long by $\frac{5}{8}$″ wide, and must be kept dry.

Bulb Syr'inge. A dentist's syringe used for blowing debris from cavities after excavating.

Fig 456.



Bulb Syringe.

A valve in the base end of the bulb admits the air instantaneously.

Bulk'head Door. A door in the bulk-head of a ship built in compartments. It is to be capable of instant closure, and self-fastening. Some are closable from the deck in emergencies. See

Bartley, Br.	* "*Engineer*," xlviii. 144.
Simey, Br.	* "*Engineer*," xlviii. 268.
Device for closing, *Simey*, Br.	* "*Engineer*," xlvii. 453, 473.
English	* "*Sc. American Sup.*," 2398.

Bulk'head Union. A pipe coupling where the pipe passes through a bulkhead or partition.

Fig. 457.

Bulkhead Union, with Flynuts.

Bull'dog For'ceps. (*Surgical.*) Forceps with pointed teeth for fistula, for grasping an artery, etc.

Figs. 131, 343, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Bull'en Nail. An upholsterer's nail, with a round head and short shank.

Carmoy's machine (Fr.) * *Laboulaye's "Dictionnaire des Arts et Manufactures,"* vol. iv., ed. 1877, article "*Clous de tapissier.*"

Bul'let. 1. A missile for a fire-arm.

Bullets with wings, the counterpart of rifling: *boulets tournants.*

Systèmes Cavalli. Gras.	Systèmes Tamisier. Buruier.

* *Laboulaye's "Dictionnaire des Arts et Manufactures,"* vol. iv., article "*Boulets*," Figs. 3426 *et seq.*

2. (*Nautical.*) Or jib-sheet block; the latter name indicating the purpose. Made of *lignum vitæ.*

Fig. 458.

Bullet.

Bul'let For'ceps. (*Surgical.*) An instrument to be introduced into a wound to grasp and extract a bullet. See BULLET EXTRACTOR, Fig. 970, p. 402, "*Mech. Dict.*"

The United States Army bullet forceps has scoop-shaped ends. Fig. 115, p. 40, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Hamilton's bullet forceps is a long-nosed pincers with toothed jaws. Fig. 124, p. 42, *Ibid.* It resembles the *sequestrum forceps*, Fig. 4834, p. 2094, "*Mech. Dict.*"

Thomasin's has scoop and claw. Fig. 128, *Tiemann.*

Gross's has loop and claw. Fig. 123 *b*, *Ibid.*

Bul'let In'stru-ments. (*Surgical.*) Instruments used in exploring for and extracting bullets from the person.

They are known by names which are expressive of their uses and application: —

Bullet forceps.	Bullet extractor.
Bullet scoop.	Bullet screw.
Bullet seeker.	Bullet probe.

Bul'let Ma-chine'. (*Cartridges.*) Lead is fed in bars, which are 2′ or 3′ long, and have the diameter of a bullet; the compressing and shaping dies cut off pieces, compress and shape them.

British, "*Ordnance Report*," 1877, Appendix L., p. 563 and Figs. 97*x*–97*z*. The process is about as follows: —

At Woolwich: The melted metal is poured into a receiver, and as soon as it solidifies, but before it is cold, it is forced by hydraulic pressure through cylindrical holes in the form of long strings. This process is to prevent the formation of air bubbles in the bullet, which would cause it, when fired, to swerve from its course. The leaden strings are thence carried to the bullet-molding department, where they are cut into lengths and roughed; then shaped in one machine, and finished in another. They have now to be plugged. These plugs were formerly made of wood, but are now prepared from a special powder, which solidifies after being pressed into form.

Bul'let Patch'ing Ma-chine'. A machine for enveloping the cylindrical portion of rifle bullets with paper, to prevent the "leading" of the grooves of the barrel.

In Borchardt's machine, the operating arrangements are on a circular table, supported by a hollow standard, through which an upright shaft passes from the actuating pulley that runs under a false floor. The connection is made by friction wheels, which insures the instant stoppage of the machine in case of any impediment. The bullets are fed to the machine by hand, and the patch is presented to the bullet and secured by a minute drop of mucilage, fed automatically, and is rolled closely around the bullet by the friction of flexible rolls, at the rate of 45 or 50 per minute, or about 20,000 per day of ten hours, including stoppages. Two operatives are required to run the machine properly. The action of the machine is easily controlled by means of a foot-lever and clutch. The machine may be adapted to all sizes and styles of rifle projectiles. The bullet-patches are cut out with dies. The patches require damping to insure neat and uniform folding.

Bul'let Scoop. (*Surgical.*) An instrument with a scoop-shaped end, to be used as a bullet extractor, the scoop being passed behind the bullet.

Tiemann's "Armamentarium Chirurgicum," Part I., p. 40, Fig. 116.

Bul'let Screw. (*Surgical.*) An instrument with a fine gimlet-screw point, to be screwed into a bullet as a means of withdrawal.

Tiemann's "Armamentarium Chirurgicum," Part I., p. 40, Fig. 119.

Bul'let Seek'er. (*Surgical.*) An instrument of the nature of a probe with an enlarged head, to introduce into a wound to find the bullet, either by

the jar of impact or by the coloration of the bulbous head of the instrument.

The references are to Part I. of *Tiemann's "Armamentarium Chirurgicum."*

Tiemann's bullet seeker has a burr head which acts as a rasp upon the bullet and shows traces of contact. Fig. 117.

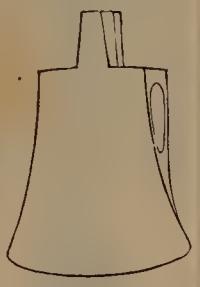
Nelaton's has a rough porcelain head which is marked by contact with the lead. Figs. 120, 126.

Tiemann's bullet seeker, Fig. 121, has a flexible stem.

Sayre's instrument has a vertebrated stem, and follows the windings of a deflected bullet. Fig. 122.

See, also, *Bullet Probes*, pp. 40, 42, as above, and p. 403 of "*Mech. Dict.*"

Fig. 459.



Bull-head Axe.

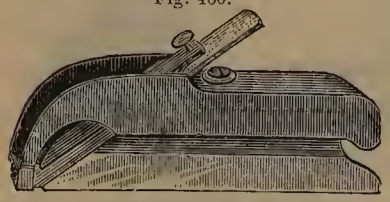
Bull'-head Axe. A poll-axe. One with a small poll for stunning a bullock, by striking it on the forehead.

Bul'lion Point. (*Glass.*) The thick portion at the center of a disk of crown glass.

Bull Net. (*Fishing.*) A large hoop-net, worked with ropes and blocks.

Bull'-nose Rab'bet Plane. A plane with the bit at the end, in order to enable it to work up close into corners. Named from a fancied resemblance to the muzzle of a bull. It is made open or close by a screw on top.

Fig. 460.



Bull-nose Rabbet Plane.

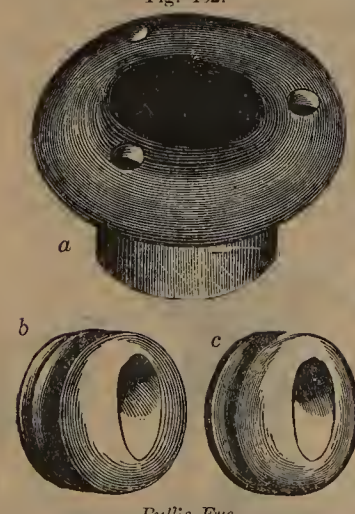
Fig. 461.

Bull's Eye.

Bull's Eye. 1. A strong round glass in a metallic frame let into a deck or side of a vessel to give light to a cabin. Fig. 461.

2. A form of rope-leader (Fig. 462) without a sheave. Known by other names also, *lizard* for instance.

Fig. 462.



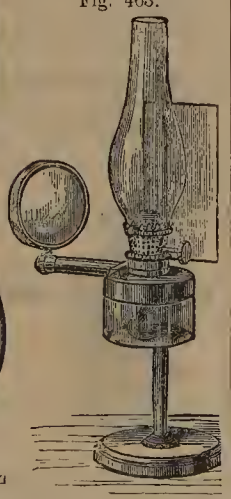
Bull's Eye.

a. Floor bull's eye of lignum vitæ.

b. Lignum vitæ bull's eye for iron straps.

c. Bull's eye for wire or hempen rope.

Fig. 463.



Bull's-eye Condenser.

Bull's-eye Con-den'ser. (*Optics.*) A means for condensing the light from a lamp, or of obtaining parallel rays from diverging ones. It consists of a plano-convex lens of deep focus. Fig. 463.

Bump. (*Fire Arm.*) The corner of the stock at the top of the heelplate.

Bung. Several forms of automatic vent, the siphon, gravitating ball, and separated chamber and ball, are shown in Figs. 2554–2556, *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iii., ed. 1877, Article "*Vin.*"

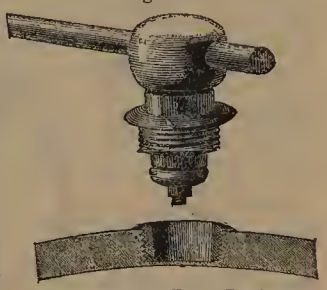
Fig. 464.

Talley's Bung and Vent.

Talley's bung has a vent in a recess, so that the bung may be driven flush with the outside of the cask. The vent has side openings and a piston valve.

Bung Buck'et. Also known as a *velinche, water thief, thief-tube,* etc. See Fig. 6925, p. 2696, "*Mech. Dict.*" A *sampling* tube. A tube open at both ends is inserted at the bung-hole; the upper end being closed with the finger, the tube with its contents is withdrawn.

Fig. 465.



Cornell's Screw Bung Bush and Wrench.

Bung Bush. More correctly, bung-hole bush. The bush is tapering inside and outside, the outer surface having a screw thread for screwing into the bung-hole. The wrench for screwing the bush into place consists of a shank and a conical plug or core; the core has an irregular base, around which are loosely fitted a series of sections, which press equally in all directions against the interior of the bush as the core is rotated.

Bung'-hole Bor'er. An auger and annular reamer. It bores a complete round hole, regular taper, and holds its own chips. Fig. 466.

Fig. 466.

Bung-hole Borer.

Bung'-hole Brush. A tool for cleaning the insides of barrels.

The illustration, Fig. 467, shows it in position for entering, and for operating, respectively.

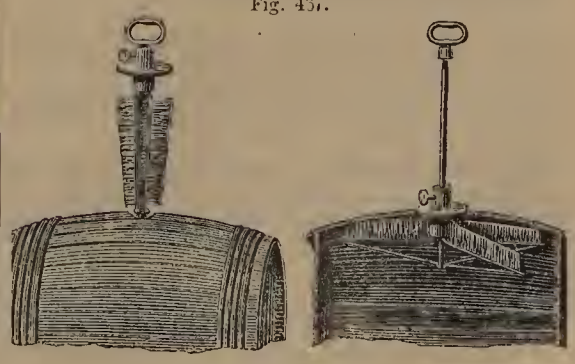
Bung Lathe. A lathe for turning taper bungs. Fig. 468.

That shown is by Arbey, of Paris. It is a small special lathe with an oblique tool on the rest which slides transversely in cutting down, and in adjusting for bungs of different diameters.

Bung Ma-chine'.

In Kirby's bung-cutting machine the square blocks are placed in a vertical pile in the hopper, and fed automatically one by one to the plunger, by which they are forced through

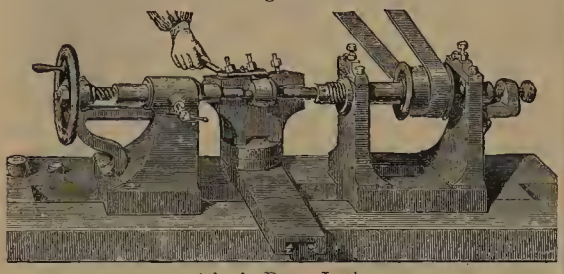
Fig. 467.



Bung-hole Brush.

the circular cavity of the cutter, and formed into cylindrical blanks. Each block as it is fed into the machine serves as a cutting-board for the next preceding block. The bungs are subjected to a great pressure so as to condense the wood.

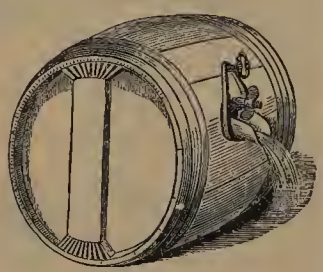
Fig. 468.



Arbey's Bung Lathe.

Bung Spout. An attachment to a cask at the bung-hole to form a lip for the latter, and enable the contents to be discharged without dribbling. Especially intended for heavy oils and molasses.

Fig. 469.

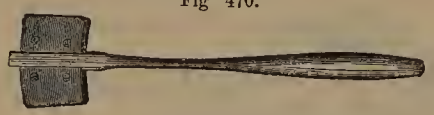


Bung Spout.

Bung Start. An instrument to start a bung by beating the bung stave of the cask. A *flogger*.

Bun'ion Ap'para'tus. (*Surgical.*) An apparatus which permits

Fig 470.



Bung Start.

freedom of motion in the vertical plane while the malposition of the toe is gradually rectified by constant lateral traction. The apparatus consists of a delicate lever of spring steel, with an oval ring in the center which is provided with hinges at its anterior and posterior margins. It is attached to the instep by a laced band, and the toe to the extremity of the spring by a piece of webbing.

Fig. 78, p. 39, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Bun'sen Bat'te-ry. (*Electricity.*) One having amalgamated zinc in sulphuric acid and carbon in nitric acid, with an intervening porous cell.

Prescott's "*Electricity*," * p. 66; Ganot, * 687, 688.
Noad, London, 1859, * 281.
Du Moncel, Paris, 1850, 69.
De la Rive, London, 1853, * 46.
Shaffner, New York, 1859, * 95.
"*Scientific American*," * xxxix. 139.
Niaudet, American translation, * 158.
"*Engineer*," xlv. 268.

Azapis' improvement consists in replacing the acidulated solution of the Bunsen by the cyanide of potassium, etc. "*Scientific American*," xxxviii. 266; xliii. 266.

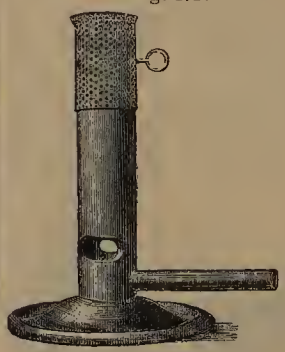
Fitzgerald, mod. of Bunsen; depolarizes by a secondary current, calcic dihydro-chromate is substituted for the nitric acid. "*Scientific American Supplement*," 764.

Bun'sen Burn'er. A form of gas burner, the invention of Bunsen, and especially adapted for heating. Its performance depends upon the proper admixture of gas and air. See 14 Figures, pp. 2411, 2412, "*Mech. Dict.*"

"It can be made of glass. A tube of glass, 4″ or 5″ long by ⅓″ to ½″ wide, is taken, and by blowing out the glass, heated at two points by the pointed flame, the air holes at the bottom are produced. The gas is introduced at the center of the bottom of the tube by an upward-bent glass quill tube, with the delivery end shaped like a cross (×), a form well adapted to mix the rising current of gas with the air. This tube is fastened to the lamp by a foot, made of plaster of Paris, in which it is imbedded. A short piece of glass tubing may be fastened by a rubber coupling to replace fractures. This lamp is much better for the flame reactions than the ordinary metal lamps." — *Dingler's Journal.*

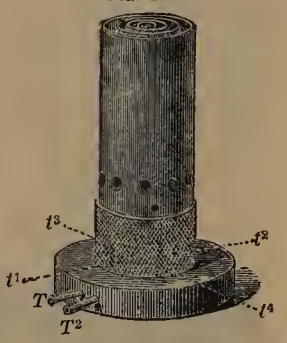
Wallace's improved Bunsen burner has an adjustable cap of perforated metallic plate, which enables it to burn a much more inflammable mixture of air and gas than is possible with the ordinary burner. The tendency to light within is also completely prevented, whatever may be the pressure, quality, or quantity of gas passing. By raising the cap to the necessary height a perfectly solid flame is obtained, — a novel and valuable feature, since it allows any substance to be heated to be put much nearer than usual to the center of the flame without interfering with combustion. It can be made from one inch to two inches in diameter, and is capable of burning as much as 40 cubic feet of gas per hour.

Fig. 471.



Wallace's Solid Flame Bunsen Burner.

Fig. 472.



Godefroy's Bunsen Burner.

M. Godefroy's new burner, Fig. 471, is composed of four concentric sheet-iron cylinders. The first and third are pierced with lateral holes at the base. The intervals between the cylinders communicate, some with the pipes, t_1 and t_2, joining the exterior gas tube, T, and others with the tubes, t_3, t_4, which unite with the tube, T_2. Wire gauze placed at the base of the apparatus prevents the flame from flickering, while it regulates the introduction of the air. Only two internal cylinders may be used if desired, in which case a high and regular white flame is produced.

Solid flame, *Wallace* . . "*Scientific American Sup.*," 100.
* "*Eng. and Min. Jour.*," xxi. 80.
Retort, *Kendall & Gent*, Br. * "*Engineer*," xlv. 419.

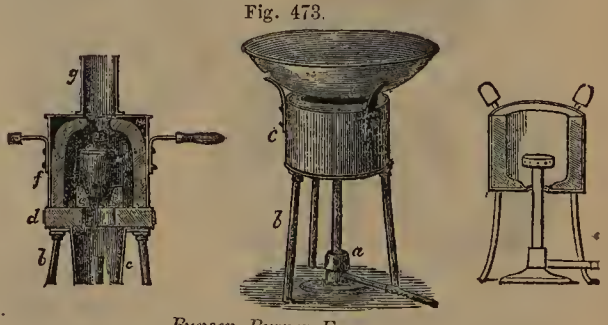
Laboulaye's "Dictionnaire des Arts et Manufactures," iv., Fig. 3462, article "*Chauffage.*"

Lecture on the theory, *Prof. Thorpe*, Chemical Society. London. Reported in "*Scientific American Supplement*," 1060.

Bun'sen Burn'er Fur'nace. Fig. 473 represents forms of the Bunsen burner furnace.

The figure on the left shows the top of a burner

Fig. 473.



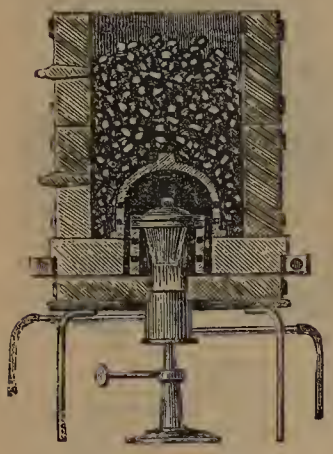
Bunsen Burner Furnace.

inside the chimney, *c*. A sole plate, *d*, rests on a trivet, *b*, and supports an iron ring, *e*. *f* is the dome covering, and *g* the chimney.

The next figure shows an evaporating furnace, and the figure on the right is a section of the same, minus the pan. It has a rose burner, which is preferable for evaporating, as the single jet is for melting metal in crucibles.

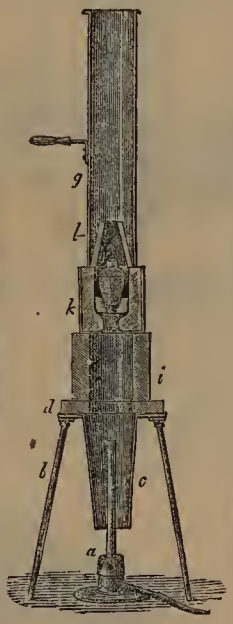
Figs. 474, 475 show other forms of the furnace

Fig. 474.



Single-jet Burner Furnace.

Fig. 475.



Bunsen Crucible Furnace.

with a single jet burner and crucibles in position on their rings.

Bun'sen Lamp. See BUNSEN BURNER.

Bun'ter. The bumper or buffer of a railway car. The bar on the front end of the car, which strikes against a similar bar on an adjacent car in coupling. It often forms the draw-head. See BUFFER.

Fig. 476.

Buntline Leader.

Bunt'line Lead'er. An eyelet for rope, — specifically for a buntline.

Buoy. The illuminated buoy is the invention of a German, *Pintsch.* The buoy is made the recipient for a large body of compressed, rich, and heavy gas, produced by distilling shale or any fatty material. An ingenious regulator provides for the regular supply of the lamp, which will burn three months, night and day, with only one filling, the light being visible at a distance of about four miles. An electric lighting apparatus might be employed, so that the light could be extinguished at sunrise and restored at night, giving a much longer duration to the working of the buoy.

* "*Engineer*" . . . . . xlvii. 289.

The illuminated buoy of Lieut. Cook, R. N., is mentioned under BUOY, "*Mech. Dict.*" Phosphide of calcium is added to the composition of the fuse, and takes fire on being wetted when the buoy is thrown overboard, and burns persistently even in rough water which dashes over it.

Bu-rette'. A graduated glass tube for transferring small quantities of fluids. See p. 408, "*Mech. Dict.*" Similar instruments are known under various names, such as DROPPING TUBE, DOSIMETER, PIPETTE, etc., which see.

Dr. Bunte's gas burette for the examination of mixtures of gases. "*Journal for Gas Lighting*," * reproduced in "*Scientific American Supplement*," * 1603.

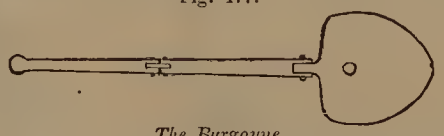
Bur'glar A-larm'. A bell, located in the sleeping room, when set for the night, rings upon the opening of any door or window in the night. The connection is by electric wires. See various forms, "*Mech. Dict.*," pp. 408, 409.

Western Electric Manufacturing Co.; the electric connection is made with any or all rooms, can be turned off in the morning by hand or automatically, can be arranged to keep on ringing until stopped; connection can be made to doors, shutters, and windows, the latter so arranged that they may be left open for ventilation at any desired height, and yet give an alarm if disturbed. The system may be connected to a police station, and applied to safes and banks.

Powell . . . . . * "*Sc. Amer.*," xlii. 210.
Window fastening, *Saurbrey*. . * "*Sc. Amer.*," xxxvii. 294.

Bur-goyne'. The British name for an intrenching tool; a combination of spade, axe, and

Fig. 477.



The Burgoyne.

mantlet. The handle is jointed to facilitate packing. The sharp-edged spade forms an axe; when used as a mantlet against bullets, the soldier fires through a hole in the blade.

See INTRENCHING TOOLS, Fig. 2691, and TROWEL BAYONET, Figs. 6673, 6674, "*Mech. Dict.*"

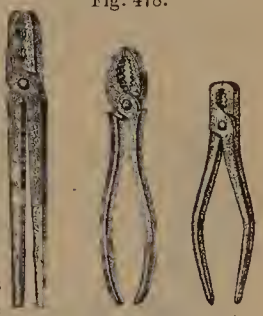
Burn'er. The tubular wick, with access of air to exterior and interior, is the invention of Argand. See page 142, "*Mech. Dict.*," and list on page 1247, *Ibid.*

Lungren . . * "*Scientific American*," xxxviii. 355.
Carcel burner . * "*American Manuf.*," Jan. 10, 1879, p. 13.

See also BUNSEN BURNER; GAS BURNER.

Burn'er Pli'ers. Pinchers for unscrewing or screwing burners and small connections. Fig. 478.

Fig. 478.



Gas-fitters' Burner and Meter Pliers.

Burned Sand. (*Molding.*) Sand in which the tenacity imparted by the clayey part has been destroyed by heat.

This happens to all that part which comes in contact with the casting, extending, in the case of large castings, to a considerable depth. It is removed as far as possible with the casting. That which remains renders the old sand weak. When fresh river or sea sand cannot be had, burned sand may be used for *partings*.

Bur'nish-er. A tool for smoothing by mechanical compression in rubbing.

Fig. 479.

Dentists' Burnishers

Fig. 479 shows an array of dentists' burnishers, for smoothing dentures and fillings.

Bur'laps. A coarse canvas used in upholstery and elsewhere.

Bur'ring En'gine. An electric substitute for the various foot-power machines which have been devised for facilitating operations on the teeth, excavating and shaping cavities, dressing down and polishing fillings, separating teeth, etc.

The speed is about 2,500 revolutions per minute. A gear-joint allows motion at any angle. The motion is reversed at will. The engine complete weighs 12 ounces.

See DENTAL DRILL.

Bur Thim'ble. An attachment to the finger to support the end of the bur drill when operating; designed for the protection of the hand and the easy operation of the instrument.

Fig. 480.

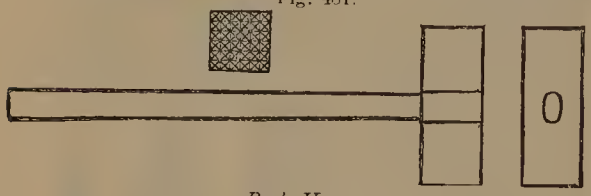
Bur Thimble.

Bush Ham'mer. (*Stone Working.*) A square prism of steel, with ends cut into pyramidal points. The cutting face is from 2″ to 4″ square. One end has sometimes the form of an axe. The tool, Fig. 481, is used in dressing and stunning.

The various forms and methods of stone working are considered under their special heads, and collections of the terms may be found under MASONS' TOOLS, etc., page 1405, "*Mech. Dict.*" and STONE WORKING, *infra*. See also lists under HAND TOOLS; MACHINES, *infra*.

Bush-ham'mered Stone Work. (*Stone Cutting.*) Work in which the roughnesses of the stone are pounded off with the bush-hammer. The sequence of operations with limestone is (1) rough-

Fig. 481.

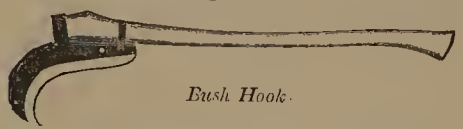


Bush Hammer.

pointing; (2) tooth-axeing; (3) bush-hammering. Sandstone is seldom bush-hammered, as the stunning makes it scale.

Bush Hook. A brier hook; bramble hook;

Fig. 482.

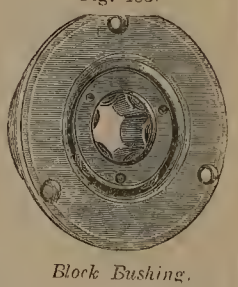


Bush Hook.

bill-hook. A hook-ended cutting tool for cutting bushes, grubs, briers, etc.

Bush'ing. (*Nautical.*) The metallic reinforce of the cheeks of a tackle-block, where the pin passes. The *bushing* of the sheave is the *coak*. See, also, BUNG-BUSH.

Fig. 483.



Block Bushing.

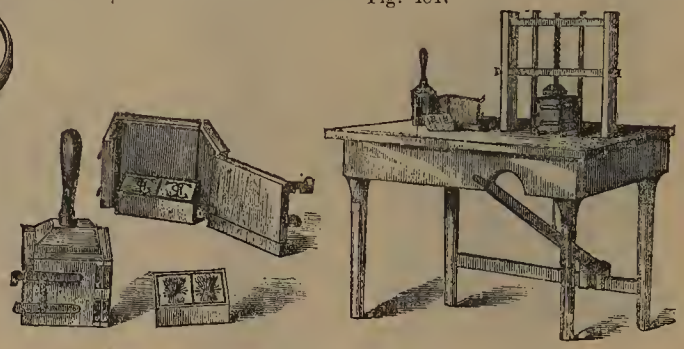
But'ter Print'er. A double-hinged mold that admits of opening out freely, and detaching itself from the butter without marring it.

The butter is weighed and placed in the mold, when it is forced by a plunger on the block at the bottom of the mold that contains the impression. The plunger is operated by a lever in connection with the main frame, and, when the pressure is removed, is retired by the action of a spiral spring. Fig. 484.

But'ter Tub. A tub in which butter is stored and shipped, especially the latter. Fig. 485.

Koehler's butter tub is oval, of white cedar, bound with galvanized iron or brass hoops. Within the tub is fitted the tin cooler, having a removable chamber for ice at each end — which is a great improvement on the old style, with stationary ice chambers — saving a great deal of inconvenience in filling the chamber with ice or removing unnecessary ice and

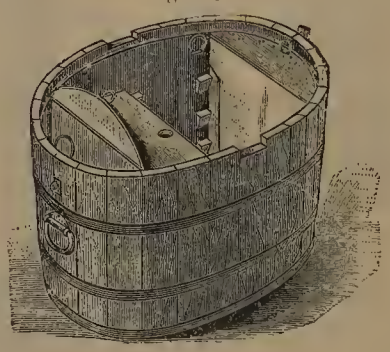
Fig. 484.



Butter Printing Apparatus.

water therefrom. On the tin are constructed a series of ledges, on which rest the shelves for supporting the print butter, being used without shelves for roll butter. The

Fig. 485



Butter Tub.

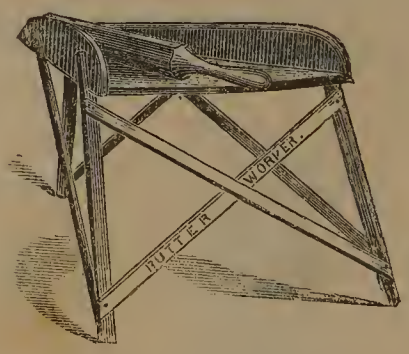
hinged cover having a fixture at one end and a hinge hasp at the other can be locked for shipping. Hinges, hasps, and fixtures are tinned to render them rust-proof.

But'ter Work'er. A tray with roller to press the butter-milk from the butter.

The illustrations show three forms with rollers.

In Fig. 486 the roller is pivoted at the end and rolls in a sector.

Fig. 486.

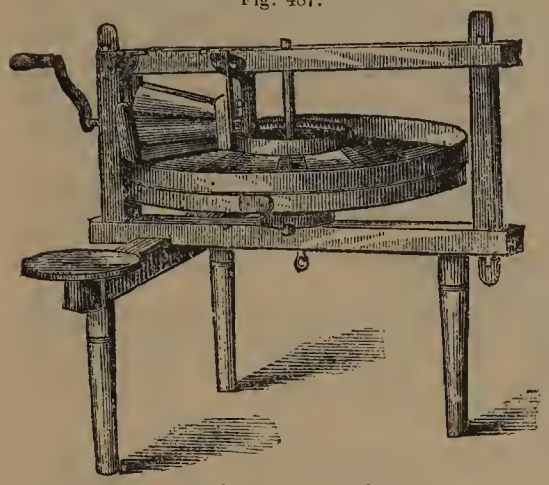


Whipp's Butter Worker.

In the rotary butter-worker, Fig. 487, the butter is placed on a rotary circular table and is confined by a rim. The crank shaft which revolves the table also rotates the frusto-conical presser that works the butter. As the presser turns, the paddles as they leave the butter slightly raise it, which allows the passage of the buttermilk to a groove around the periphery whence it passes by a tube to the well in the center of the table.

The butter-worker, Fig. 488, consists of a tray, and a roller with paddles which is turned by a crank, and traverses from end to end of the tray. The roller is removed from the tray by turning the long end of small buttons on the side of the tray, which admits of the roller coming nearer to the end of the tray, and allows the clamps which hold the

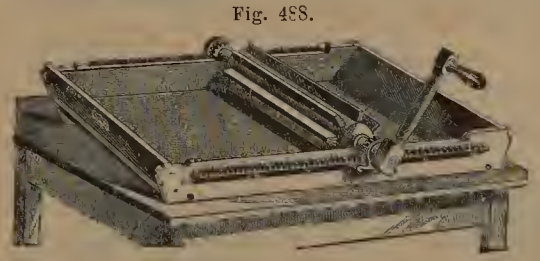
Fig. 487.



Embrie's Butter Worker.

roller down to be raised from the rack underneath, when the roller can be lifted out.

Fig. 488.



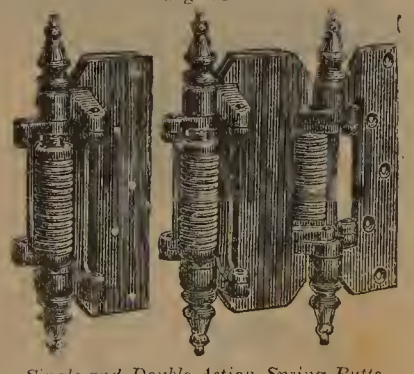
Reid's Butter Worker.

May refer to

Butter, Artificial, *Mott.* "*Scientific Amer. Sup.*," 760, 774.
"*Scientific American*," xxxv. 337.
Packing, *Bemis* . . . * "*Scientific American*," xxxvii. 66.
Worker, *Sands* . . . * "*Scientific American*," xxxvii. 5.

Butt Hinge. A door or casement hinge adapted to be fastened to the edge of the object, and hidden when the latter is closed. Differs from the hook strap, T, and other long-membered or ornamental hinges which are displayed upon the door.

Fig. 489.



Single and Double Action Spring Butts.

Geer's butts, shown in Fig. 489, exhibit several points of value. The figure on the left is for a single door of the usual action, but with a spring to close the door automatically and having its greatest power at the point of closure, the least when opened to a right angle; and also holding the door in open position. The double action hinge allows the door to swing either way. They are not rights and lefts, but adaptable to either edge of a door.

Loose-pin . . . . . * "*Iron Age*," xxi., April 11, p. 9.
Spring, *Geer* . . . . * "*Iron Age*," xxi., Feb. 7, p. 1.

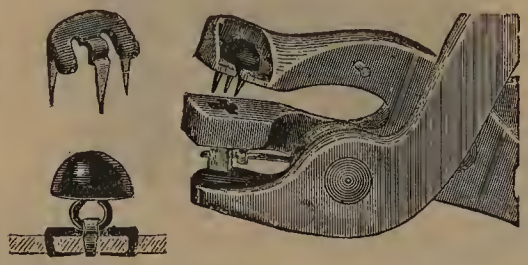
Butt Lathe. A stock-turning lathe, invented by Blanchard. A gouge 18″ in diameter, that makes from 3,400 to 3,600 revolutions per minute, is guided by an iron pattern the shape of the stock required. The stock goes through a set of these machines before it is ready for polishing.

But'ton. (*Surgical.*) A species of clamp for holding the suture, in operations for vesico-vaginal fistula. The invention of *Bozeman.*

See Figs. 268–271, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"
The *button-adjuster* and *button-shaper* are accessories.

But'ton Fas'ten-er. A clasp which hooks over the eye of a shoe button and is then clinched to the shoe.

Fig. 490.



Heaton's Button-setting Instrument.

The illustration shows the article, its attachment, and the tool. It is applied without previous piercing of the leather; has sufficient freedom of motion; can be removed by unclinching the points.

Button apparatus, Covered . . * "*Sc. Amer.*," xxxvii. 175.
Button sewing-machine, *Fries.* * "*Sc. Amer.*," xxxv. 6.

But'ton-head Bolt. A carriage bolt with spheroidal head. Fig. 491.

Fig. 491.

Button-head Carriage Bolt.

But'tress. (*Add.*) Buttresses are
Close, like extended pilasters.
Open, with perforations in the profile.
Flying, with half an arch suspended, bearing against the clerestory or a wall.

But'ty-gang. A word used among English contractors to signify a gang of from 10 to 13 men, who do a piece of work for a given sum divided equally among them, except a small additional sum to the head of the gang. *Helps's* "*Life of Thomas Brassey.*"

Buz'zer. 1. A small, rapidly-revolving wheel, used in grinding or polishing small objects. It is plied with emery, eroeus, rouge, etc., according to requirements. Named from its whirring sound.

2. A telegraphic call in which a vibrating hammer strikes a sounding piece and gives out a buzzing sound, which, in certain cases, is preferable to a bell.

Buzz Pla'ner. A small planing machine for wood. It is named from the whirring hum of its rapidly revolving knife-cylinder, and is used to take out of wind and smooth up small stuff.

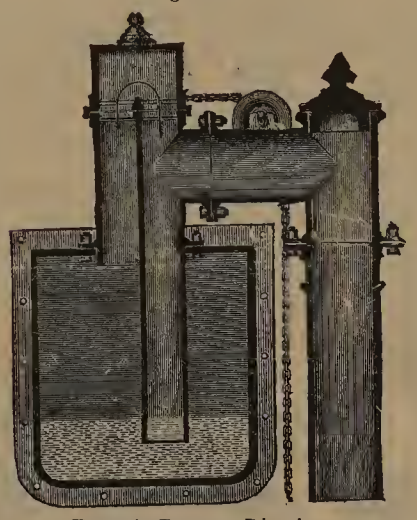
Bye'-pass. 1. A cut across furnished by an extra pipe of smaller dimensions, leading around a certain chamber, valve, or apparatus which is temporarily cut out of the circulation.

The *bye-pass* is found in: —
Mackenzie's surface condenser.
* "*American Gas-light Journal*," July 3, 1876, p. 12.
Smith & Sayre's gas exhauster.
* "*American Gas-light Journal*," *Ibid.*, pp. 10, 11.
Woodbury & Merrill's hot-air engine. *Infra.*

The illustration shows Farmer's hydraulic main, with dip-pipe and bye-pass. — "*American Gas-Light Journal*," July 3, 1876, p. 20.

See Gas Compensator; Gas Exhauster.

Fig. 492.



Farmer's Bye-pass Dip-pipe.

2. A protecting pipe around the tip of a gas-burner to prevent the light being extinguished by a gust of wind. Used in lighthouses. See Major Elliot's Report, U. S. Engineers. The top of the bye-pass is pierced with holes supplied with gas from a source independent of that of the main flame, and will relight the former immediately, should it be extinguished.

See, also, paper by Wigham, Mechanical Science section of British Association, 1878, reproduced in "*Scientific American Supplement*," * 2329.

Byrne Bat'te-ry. (*Electricity.*) A form of pneumatic battery.

The negative electrode consists of a copper plate, coated with lead on one side, and the other side faced with platinum. Two of these are used, between which is a zinc plate. The exciting liquid is agitated by injection of air.

"*Niaudet*," American translation, 226.
"*Scientific American Supplement*" . . * p. 2526, Fig. 36.
"*Telegraphic Journal*" . . . . . * vi. 222, 269.
"*Engineer*" . . . . . * xlv. 279, 406.
"*Scientific American*" . . . . . * xxxviii. 293.

Dr. J. H. Thompson's Report, "*Centennial Exhibition Reports*," vol. vii., Group XXIV., p. 53.

C.

Cab. 1. A city passenger vehicle for hire by course or hour.

2. The shelter on a locomotive for the engineer and fireman.

See notices: —
Chariot cab, *Murch* . . * "*Scientific American*," xliii. 191.
Murch . . Patents 147,421, 152,244, 154,572, 151,240, 149,779.
Herdic . . * "*Scientific American Sup*," 3901.
Locomotive cab.
Pa. Railway . . . * "*Engineering*," xxiv. 105.

Cab'in. A saloon for officers or passengers on board ship.

Swinging cabin, *Bessemer*, "*Van Nostrand's Mag.*," xvi. 569.

Cab'in Car. (*Railway.*) A car carried at the rear of a freight-train to accommodate the conductor and train-hands. Known also as a *caboose*.

Pennsylvania Railway . . * "*Engineering*," xxiv. 413-417.

Cab'i-net Ma'ker's Clamp. A species of vise for bringing parts of a frame together and

Fig. 493.

Cabinet Maker's Clamp.

holding them. The heads are adjustable by stirrups on the rail, which has a notched lower edge, and one of the heads has a screw for clamping the object.

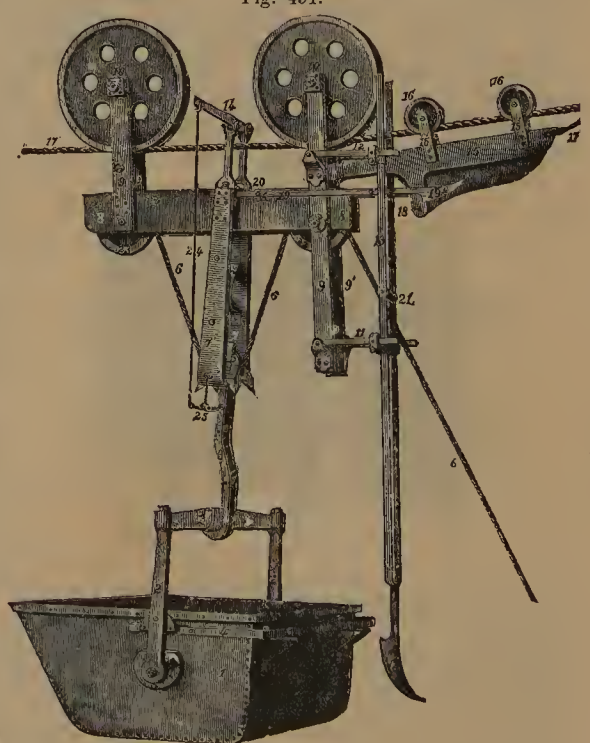
Ca'ble. A large rope, warp, or hawser.

The catenary of a suspension bridge.

East River Suspension Bridge.
* "*Scientific Amer.*," xxxvii. 63.
* "*Scientific Amer.*," xxxviii. 303-6.
Fastening . . . . * "*Scientific Amer.*," xxxvii. 79.
Making . . . . . * "*Scientific Amer. Sup.*," 755.
Gear, wire.
S. S. "Moewe," Br. * "*Engineer*," l. 494.
Grapnel . . . . . * "*Scientific Amer. Sup.*," 979.
Grappling, *Capt. Stead* * "*Iron Age*," xxi., June 6, p. 3.
Hauling gear, telegraph.
Johnson & Phillips, Br. * "*Engineering*," xxix. 205.
Making for suspension bridges.
Hildenbrand . . . * "*Van Nost. Mag.*," xvii. 171, *193.
Towing . . . . . * "*Scientific American*," xli. 143.

Ca'ble Car'ri-er. A means of transporting rough materials; stone, sand, lime, coal, earth, by a suspended bucket traveling on a wire cable. Fig. 494.

Fig. 494.



Brown's Cable Carrier.

While filling the tub, the carrying bail 2 is turned back, and when filled the bale is turned upright, and there locked by the dumping bail 4. The bail is then attached by hook 3 to block 5, through which the hoisting rope 6 passes, thence

over pulley 22, to the hoisting drum (not shown.) When the load is raised, the upper edge of block 5 enters between the inwardly curved ends of the hooks 7, 7′, which separate and pass over the block, falling together beneath it. The block is then lowered and rests upon them, transferring the load from the rope to the hooks.

These hooks are attached to levers 19 pivoted at *A* and having a limited movement, the weight depresses their inner and raises their outer ends, unhooking them from pin 18 on the holding block 15. Simultaneously with the transfer of the weight to the hooks, the hoisting rope and drum are released from the power and the carriage with its load descends the cable 17; and when it reaches the point where it is desired to deposit its load, the drum is again thrown into connection with the power, arresting the outward progress of the carriage, and starting it simultaneously upon its return. The hoisting rope, passing under roller 21, between the two parts of dumping hook 13, is by it deflected downwards as the carriage passes out, and when the drum is thrown into gear the straightening of the rope raises the hook which is pivoted upon levers 11 and 12, brings its point, 13′, in contact with the dumping bale, unlocks the tub, which capsizes, ejects its contents, attains its upright position, and relocks itself while upon its return.

When the carriage reaches the holding block it is stopped, and the tub is raised until the block, acting upon projections 26 on the inner sides of the hooks, forces them apart sufficiently to allow of its passing down between and clear of their points. A notch on lever 14 retains them apart until the block has passed their points and strikes the jointed lever 25, which, through rod 24, raises lever 14, releasing and allowing them to fall together.

The tub is then lowered and the operation repeated.

By the use of this machine (hoisting power being furnished) material can be conveyed a thousand feet, and piled to any height, with the labor of one man.

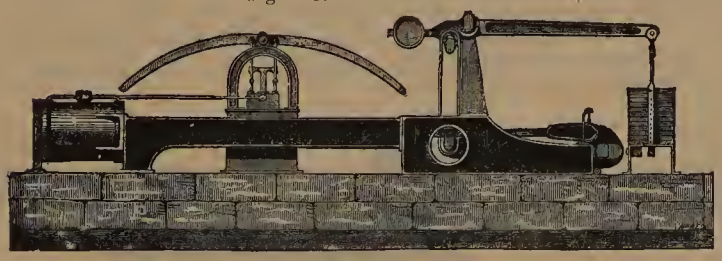
See, also, WIRE-WAY, Fig. 7006, p. 2798, "*Mech. Dict.*"

Ca′ble Screw. A fastening for boot-soles; a wire in shape of a twisted cord.

Ca′ble Screw Ma-chine′. One for putting screw pegs into boot and shoe soles. It goes round the sole in 15 seconds, putting in 80 to 85 wire pegs.

Ca′ble Test′ing Ma-chine′. The machine shown in Fig. 495 is made in accordance with the

Fig. 495.



Chain Cable and Anchor Testing Machine.

"Board of Trade" (British) regulations, operating by medium of dead levers upon an active weight. The series of levers is similar to that in compound beam scales, the strain being given by a hydraulic ram of 8′ stroke. The great length of stroke is for the purpose of taking up the stretch of the cable when testing lengths of 20 fathoms at a time. The machines are made to test up to 200 tons. A hydraulic gage indicates upon a scale the strain upon the levers.

For chain-testing establishments, in addition to the testing machines there are required steam-pumping apparatus, cable-shears for cutting out defective links, capstans for hauling the chains, a hydraulic anchor crane, and a blacking apparatus; it is usual also to add a more powerful short machine to test a few links of the largest cables to destruction.

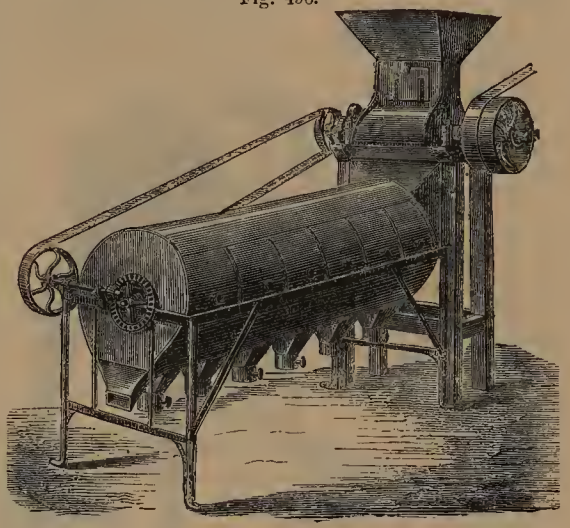
The cable-testing apparatus of Giffard's captive balloon, Paris, 1878, was a hydraulic press mounted above a frame so as to bring a strain upon a section of the cable which had two eye-splices to the holder and puller respectively, the latter depending from the piston of the press. An accumulator is arranged to prevent any shock from the rupture affecting the manometer which registers the tension.

"*Scientific American*". . . . . * xxxix. 194.

Ca′bres-to. A halter. A word of Spanish introduction used on our Western plains. Properly *Cabestro: Cabresto* in Portuguese.

Ca-ca′o Grind′er and Sort′er. A machine for grinding the cacao nut and sorting the result

Fig. 496.



French Cacao Machine.

into different finenesses. The distance between the cylinder and its concave is adjustable in order to determine the fineness of the result. The ground cacao is sorted into six sizes, and refuse.

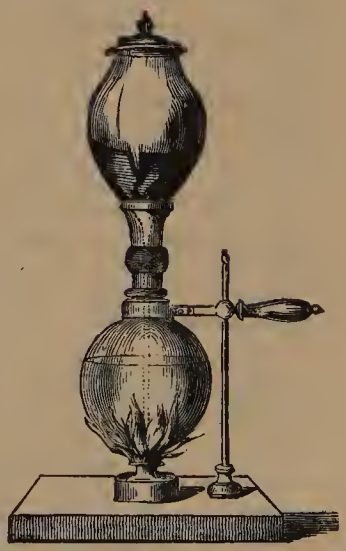
In the cacao mill of De Batiste, Paris, France, the cacao is put in a hopper having at the bottom a screw which partially grinds the nut and feeds it into the center of a pair of stones, similar to a pair of grist-mill stones. These grind it into a liquid which collects in a pan surrounding the lower stone.

Cacao manufacture . . . . . "*Sc. American Sup.*," 1014.
Chocolate machinery, *Menier* . "*Engineering*," xxv. 443.
Cocoa . . . . . " *Sc. American*," xxxv. 278.

Cafe-ti-ere′. A French apparatus for making infusion of coffee.

The apparatus has two bulbs and connecting neck with ejector tube.

Fig. 497.



Cafetière.

As shown in Fig. 497 the lower bulb contains water which is in process of being heated by the alcohol lamp. When steam forms above the water, the latter is raised in the central tube and poured down upon the ground coffee in the upper vessel. The lamp is then removed, the steam soon condenses and the water is drawn down through the coffee so as to have the grounds as dry as fresh sawdust.

The *Etzenberger* steam tea and coffee filter is on larger scale but involves the same principle of action.

Cage. (*Add.*) 6. A prison of iron bars.

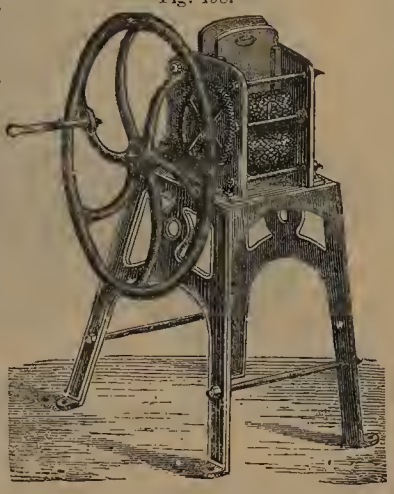
Iron cages are now frequently made for prisons in the South and West, to be used when there is no conveniently available material except wood.

Cais'son. An iron-lined shaft; or a shaft used in pneumatic subaqueous excavation. Pages 49, 420–422, "*Mech. Dict.*"

Arsenal of Nagasaki . . . . * "*Engineer*," xliv. 60–64.
Air-lock, Hudson River Tunnel * "*Engineer*," l. 327.
Subaqueous, Antwerp . . . * "*Engineering*," xxviii. 280.

Cake Grind'er. A machine for breaking linseed oil cake for food for stock. The cake is dropped into the hopper edgewise, is broken in pieces, and these ground by passing between toothed rollers.

Fig. 498.



Oil Cake Grinder.

Cake Ma-chine'. A machine for cutting dough into cakes.

Ruger's soft cake and jumble machine takes the dough previously prepared in a dough mixer, spreads it on an apron, and cuts it into cakes of the required size and shape; cakes, snaps, jumbles, drops, fingers, bars, etc. The cakes are taken from the apron with a peel. There is no automatic scrapper as in some forms of cracker machines. See CRACKER MACHINE.

Cake Steam'er. A machine for *washing* cakes, snaps, and crackers. It has an iron frame having an endless chain apron for carrying the pans of cakes underneath a dome where steam and water are sprayed upon the cakes, causing them to spread, and then by filling the dome with hot steam a thin skin forms over the cakes, by which, when baked, they acquire a rich, cracked top, and glossy color.

Çal-cim'e-ter. An instrument invented by Scheibler, and modified by Pellit & Salteron, for making volumetric analyses of bone-dust, meerschaum, and other compounds containing lime.

"*Scientific American Supplement*" . . * x. 4002.

Cal'ci-mine. A superior kind of wash for walls. See also KALSOMINE, "*Mech. Dict.*," p. 1222.

Cal-cin'ing Fur'nace. A furnace for roasting ores.

In the Gestenbrofer furnace, named after the inventor, was first introduced the feature of burning the sulphur of pyritic ores to accomplish the calcination.

In practice, the sulphurous fumes are used to make sulphuric acid, which is used to make soda from common salt.

See paper by Holloway read before the "Society of Arts," London, February, 1879, "*On a New Application of a Process of Rapid Oxidation by which Sulphides are Utilized for Fuel*," referred to in "*Engineering and Mining Journal*," xxvii. 201; xxix. 423.
See also *Dr. Jenkins's* report, "*Paris Exposition Reports*," 1878, vol. iv., pp. 9 *et seq.*, 74, 80 *et seq.*, etc.
Boston and Colorado Works . . . . . * "*Engineering*," xxii. 290.
Borrie, Br. . . . . * "*Iron Age*," xxiii., June 12, p. 1.
Howson & Wilson, Br. . * "*Iron Age*," xxiii., June 12, p. 1.

Cal'ci-um Light. An improved form of the calcium light has been invented by *Khotinsky*, a Russian naval officer.

A thin pyramidal crayon of lime or magnesia is supported (adjustably) in a vertical position, with its thinner end facing the orifice of the burner below, which surmounts two tubes, for coal-gas and oxygen, both controlled by one stop-cock. The two gases only mix at the mouth of the burner. The crayon, immersed in the flame, is successively heated from below, without any sudden difference of temperature occurring in its several parts. The same crayon will last fifteen days, with daily use. The burner consumes about 0.014 cub. meters of oxygen per hour, and as much coal-gas, giving a light equal to about 1.5 Carcel burner.

Cal'cu-la-ting Ma-chine'. An arithmometer. "*Mech. Dict.*," pp. 143, 144.

Circle, *Boucher* . . . * "*Engineering*," xxvii. 498.
Grant . . . . . * "*Engineer*," xliv. 12.
* "*Scientific American*," xxxvi. 295.

Babbage's and Scheutz's * machines, described, article "*Calculer, Machine à*," *Laboulaye's* "*Dict. des Arts et Manufactures*, vol. iv., ed. 1877. See also pp. 423-24, "*Mech. Dict.*"
Stamm's "*Machine à equations*," * *Ibid.*

Cal'en-der-ing Ma-chine'. 1. (*Laundry.*) A machine for smoothing clothes or linen. A mangle. Much used in France. Machines of this character are made by Pierron & Dehaitre, Paris. See LAUNDRY.

2. Machines for smoothing piece goods in course of manufacture after washing, dyeing, bleaching, etc.

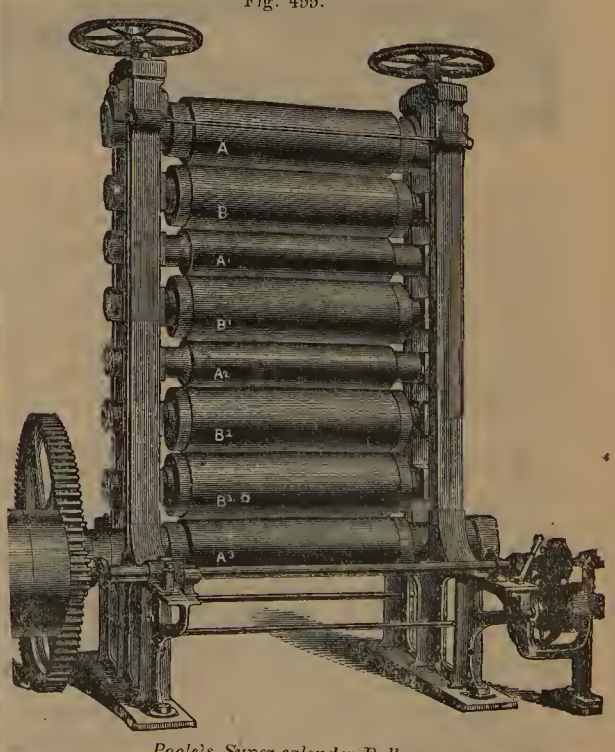
See Fig. 1026, p. 426, "*Mech. Dict.*" Also Fig. 252, article "*Blanchiment*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome i., ed. 1877.

3. A machine for giving lustre to stuffs by pressure, which may be accompanied by heat. The French calendering machine has rollers of plane tree wood or paper alternating with cast iron.

See *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," *article* "*Calandre*," Fig. 498, tome i., ed. 1877.

Fig. 500 is a French machine of two cylinders, of which the lower one is paper covered. The iron roller is adapted to be heated by steam or gas. Machines of the same class, with three cylinders, are made, adapted for cloths or linen, for the use of dressers, dyers, laundries, etc. See also BEETLING MACHINE.

Fig. 499.



Poole's Super-calender Rolls.

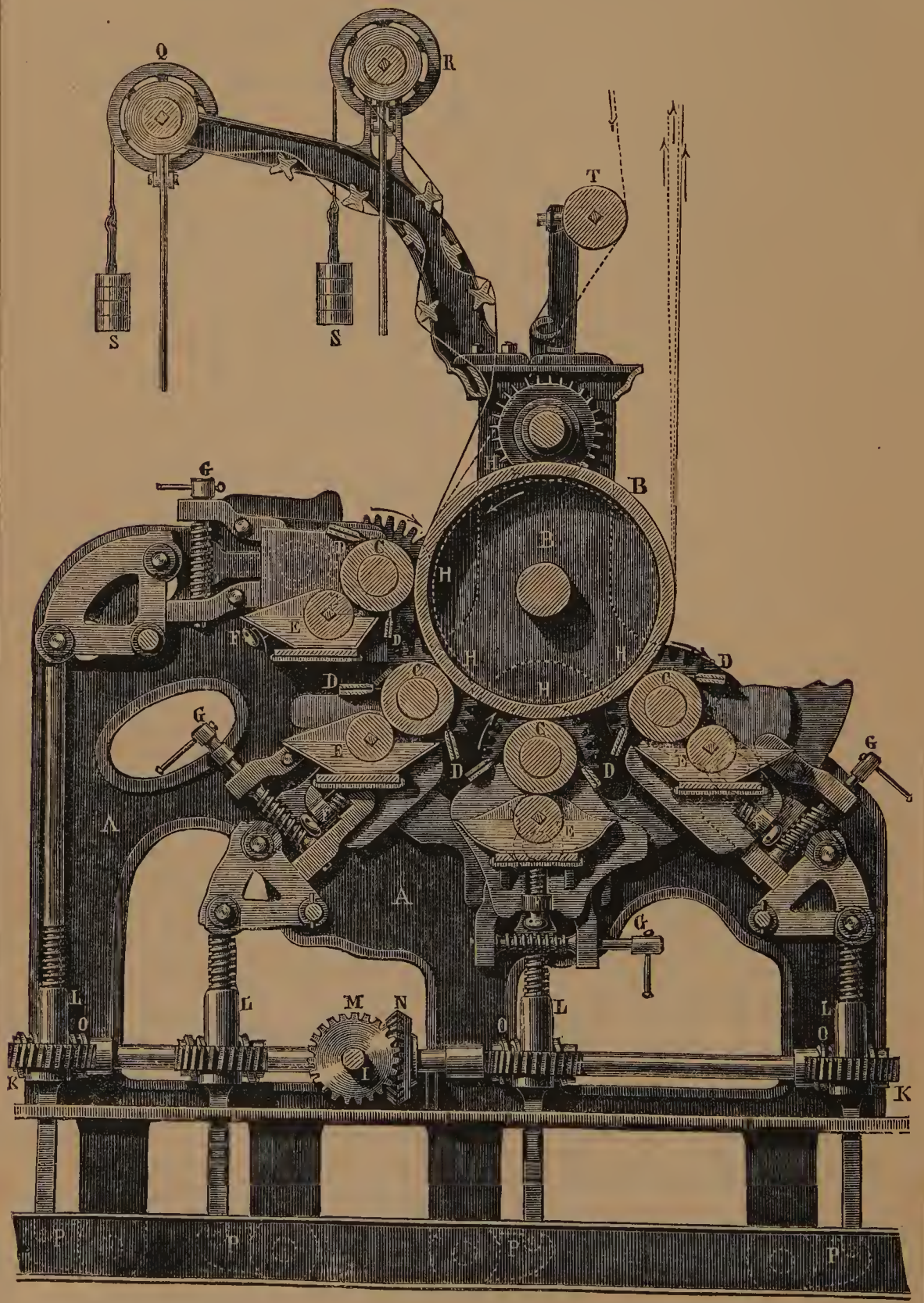
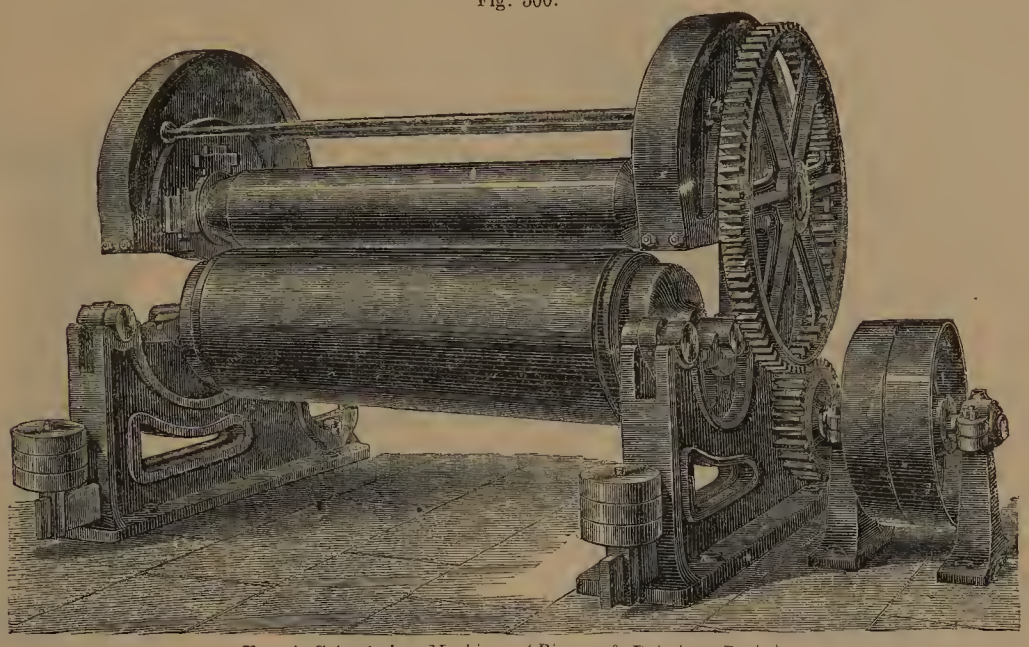


PLATE VI. CALICO PRINTING MACHINE. (In four colors.) *See page* 153.

Fig. 500.



French Calendering Machine. (*Pierron & Dehaitre, Paris.*)

Small machines are made for watering or moiring ribbons, etc.

4. In paper-making for expressing the moisture from the felted web, and giving a surface to the incipient paper.

Poole's calender rolls are shown in Fig. 499.

The figure represents a stack of super-calenders for a paper machine, but their rolls are adapted for various uses, working in paper, rubber, gutta-percha, brass, copper, flour, etc. As shown, the rolls *A A'*, etc., are of chilled iron, *B B'*, etc., are paper. The number and dimensions are varied to suit the work required of them. They are put in motion by a friction pulley, and the strain is carried by large wrought iron rods, connecting the caps of the upper with the lower bearings of the lower roll. The gearing at the side belongs to the winding arrangement.

5. A machine for running rubber into sheets, or spreading it upon cloth.

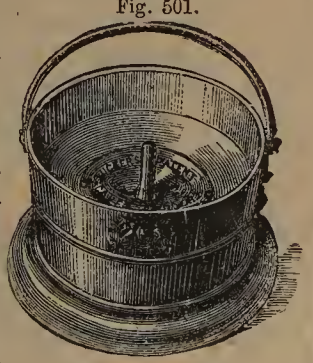
When the rubber has been thoroughly mixed, it is, by means of large iron calender rolls, "run" into sheets of the required thicknesses — three to four feet wide — and then rolled or cut into various shapes and sizes, and made up by the workmen into the various articles required, ready for vulcanizing. Cotton fabrics are combined as a base of strength with the sheets intended for belting, hose, and other articles requiring it.

"*Engineering and Mining Journal*," * xi. 1.

Machine, *Voith*, Ger. . * "*Engineering*," xxviii. 392.
* "*Engineering*," xxx. 68.
* "*Scientific American Sup.*," 3899.
Rolls, *Poole* . . . . * "*Scientific Amer. Sup.*," ii. 559.
Of paper . . . . . * "*Sc. American*," xxxvi. 360.
Grinding, *Poole* . . . * "*Sc. Amer. Sup.*," vii. 2769.

Calf Pail. A pail for feeding a young calf. The teat in the center is hollow, and the milk is drawn through it by the natural action of sucking.

Fig. 501.



French Calf Pail

Calf muzzle, *Miller*, * "*Sc. Amer.*," xxxvi. 386.

Cal'i-co-print'ing Ma-chine'. A machine for printing tissues. It was originally designed for cotton prints or calicoes, but has more lately been applied to a very great variety of fabrics of wool, linen, silk, and other materials, and of various mixtures of these and others.

The modes of printing are various, but the greater number concern the chemical side of the question and are described on pages 426–429, "*Mech. Dict.*"

Plate VI. shows a machine for printing in four colors which will give a clearer understanding of the construction and operation than one for printing in twenty-four colors, which might have been selected. The latter has a larger central cylinder so as to make it possible to arrange around it a series of twenty-four different impression rollers, each having its own paraphernalia of color-roller, color-trough, doctor, and the necessary means for adjustment.

The plate shows a transverse vertical section of the machine. A, is the frame of the machine on which the various parts are mounted. B is the impression cylinder, and around it are four engraved cylinders, C C C C, which receive their color from felt-covered copper rollers which revolve in the color-troughs, E E E E. Each of the graven cylinders has two doctors, D D, one to remove superfluous ink in advance of the impression being delivered, and the other one to catch and remove any fluff or fibre which might adhere to the cylinder and so be carried into the color. The doctor is a steel blade held by an adjustable screw against the cylinder and having a back and forth movement in the direction of its length.

The plate shows three webs passing around between the impression cylinder and the engraved cylinders. That passing from Q is the fabric to be printed. It passes over several wing-rollers and flat surfaces which spread it evenly and remove folds and wrinkles; the tension being maintained by a weighted strap, S, which acts as a brake upon the axes of the cloth roller and prevents its paying out too fast.

Next to the tissue to be printed is a cloth called a doubler (*doublier*) which unrols from R and has the same smoothing devices and brake weight S as previously mentioned.

The doubler lies at the back of the fabric to be printed, and is itself backed by an endless blanket, which is shown coming past the roller T and the

spiked roller H; this lies next to the impression cylinder, the doubler and blanket together acting just as the blankets of an ordinary copper-plate printing-press, to form an elastic spongy backing to the fabric and force it into the graven lines from which it absorbs the colors.

Each graven cylinder, as has been said, has its own set of devices, color roller, and trough, and these, with it, are mounted upon a carriage which can be set towards or from the impression cylinder B. A system of gearing, M N O L K, actuates these altogether, but individual adjustments of any one set are made by a screw G, which acts upon its own set.

The cylinder is rotated by a gear-wheel on its shaft, and the graven cylinders by the planetary gears H H H H.

On the right are shown the tissue, with the doubler and the felt proceeding toward the drying chamber.

The Monteith (Glasgow) hydraulic press, for calico printing from flat plates, is shown in article "*Impression sur Etoffes*," Fig. 43, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iii., ed. 1877.

Machine for printing in 24 colors. *Ibid*, Fig. 63.

Cf. "*Sketch of the History of Calico.*" Paper read before a literary society of Melrose, Mass. "*Boston Journal*," reproduced in "*Scientific American*," xli. 401.

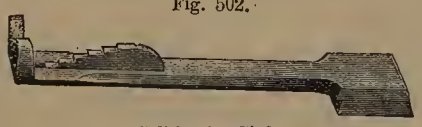
Copper facing calico rolls. "*Iron Age*," xix., June 14, p. 20.

Cf. O'Neill's "*Chemistry of Calico Printing*," etc.

O'Neill's "*Dictionary of Calico Printing and Dyeing.*"

Cal'i-for'ni-a Sight. A hind sight for a gun;

Fig. 502.

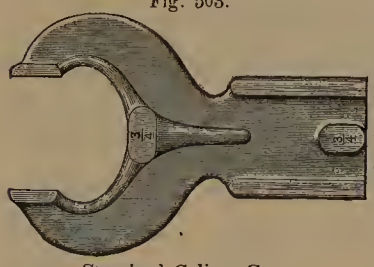


California Sight.

capable, by elevation of the rear portion on one or other of the steps of the fin, of adjustment for ranges of varying distance. Fig. 502.

Cal'i-pers. Standard calipers are made for outside and for inside measurements; the prongs answering for the former, and the bar for the latter. They are preferred to plugs and rings for some purposes. See CYLINDRICAL GAGE. They are both light and strong. They are used as standards in a shop, to which all workmen's measurements must conform.

Fig. 503.



Standard Caliper Gage.

Each full set of these gages is arranged in a case, and contains sizes from $\frac{1}{4}''$ to $2\frac{1}{2}''$ diameter, varying by $\frac{1}{16}''$.

Form and use of . . . . . * "*Sc. Amer.*," xxxvi. 3.
Manufacture of . . . . . * "*Sc. Amer.*," xxxviii. 85
Micrometer, *Brown & Sharpe* * "*Sc. Amer.*," xxxvi. 9.
Gages and caliper machines, "*American Manufacturer*," 1879, March 28, p. 13, and April 4, p. 13.

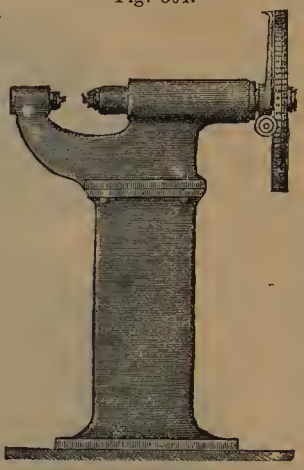
Cal'i-per-ing Ma-chine'. A machine, Fig. 504, used in a shop for testing work. A sort of stationary caliper, with capacity for fine adjustment. It is on the principle of the Whitworth measuring machine, Fig. 3104, p. 1414, "*Mech. Dict.*."

It has a fine screw, with a large graduated wheel, and a tangent screw for fine adjustment.

"*American Manufacturer*," * 1879, April 4, p. 13.
"*Iron Age*" . . . . . xxiii., Jan. 30, p. 3.

Cal'i-per Rule. One with a sliding member which protrudes at the end; the foot may be used to measure outside dimensions, in the manner of calipers. Fig. 506.

Fig. 504.



Calipering Machine.

Calk'ing I'ron. A chisel by which oakum is driven into the seams between the planks of a wooden ship. The chisels vary in form according to the size or position of the seam. Fig. 507.

Calk'ing Joint. One tightened by a calking tool, as in some riveted boilers.

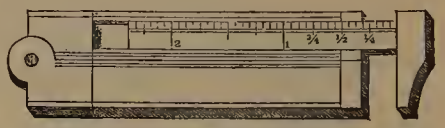
Fig. 505.

Connery's Method of Calking.

Connery's method of calking is with a round ended tool instead of one with an angle edge. The advantage is that it does not cut the iron, making incipient cracks, but simply drives the metal in between the two sheets, wedging it tight. The dark parts in the cut represent the portions disturbed by the tool.

Cal'lan Bat'te-ry. (*Electricity.*) A modified form of Grove battery in which the platinum and nitric acid are replaced by platinized lead and a mixture of sulphuric and nitric acids, and saturated solution of nitrate of potassium.

Fig. 506.



Caliper Rule.

"*De la Rive*," London, 1859, 283.

Fig. 507.

Calking Irons.

Call An-nun'ci-a'tor. An audible call device which has, in addition to the gong, a board on which are arrows (or what not) which indicate the source whence the call proceeded. Such are used in hotels and elsewhere. See ANNUNCIATOR, "*Mech. Dict.*"

Cal'laud Bat'te-ry. (*Electricity.*) The original gravity battery, invented by Jean Armand Callaud. See p. 430, "*Mech. Dict.*"

Prescott, "*Electricity*," 79.
Niaudet, American translation, * 118.
Plush, imp't on Callaud, * "*Sc. Am. Sup.*," 2655, * 2751.
* "*Engineer*," xlvii. 333.
"*Journal Franklin Institute.*"

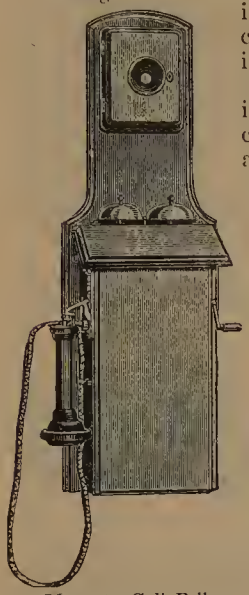
Call Bell. A bell situate to be sounded by the distant closing of an electric circuit.

Such are used constantly on telegraph and telephone circuits.

The illustration, Fig. 508, shows the latter. Above is the *transmitter*, below are two call-bells; on the left hangs the *receiving* instrument; on the right is the crank of the magneto-electric instrument.

A *buzzer* is sometimes used instead of a bell to call a clerk without making a noisy alarm.

Fig. 508.



Magneto Call Bell.

Fig. 509.

Call Button.

Call But'ton. A small stud which is pressed to close an electric circuit and sound a gong at a distant station; an office, guard-room, servants' quarters, or what not.

Fig. 509 shows one which is stationary in a wall; another pendent at the end of a cord.

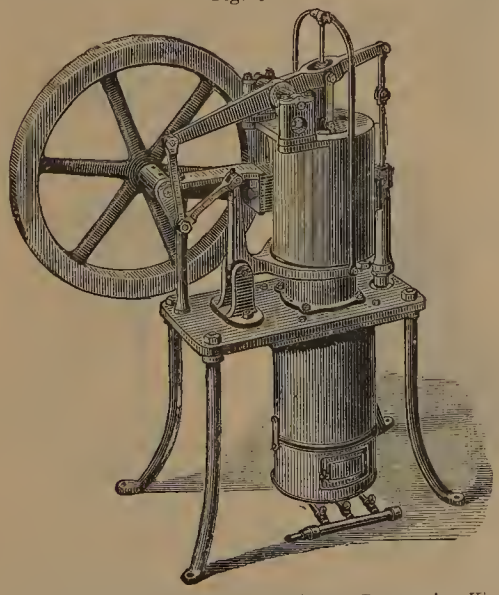
Cal'li-graph'. A writing machine.

Cal'o-ric En'gine. The name given by *Ericsson* to the heated-air engine. His earlier form of engine was given in Fig. 84, p. 40, "*Mech. Dict.*," and accompanying description. His device was followed by a host of others. See Figs. 85–94, pp. 41–45, *Ibid.*

The illustrations below show the latest and a very compact form of the *Ericsson* engine.

Fig. 510 is a perspective, and Fig 511 a sectional view of the

Fig. 510



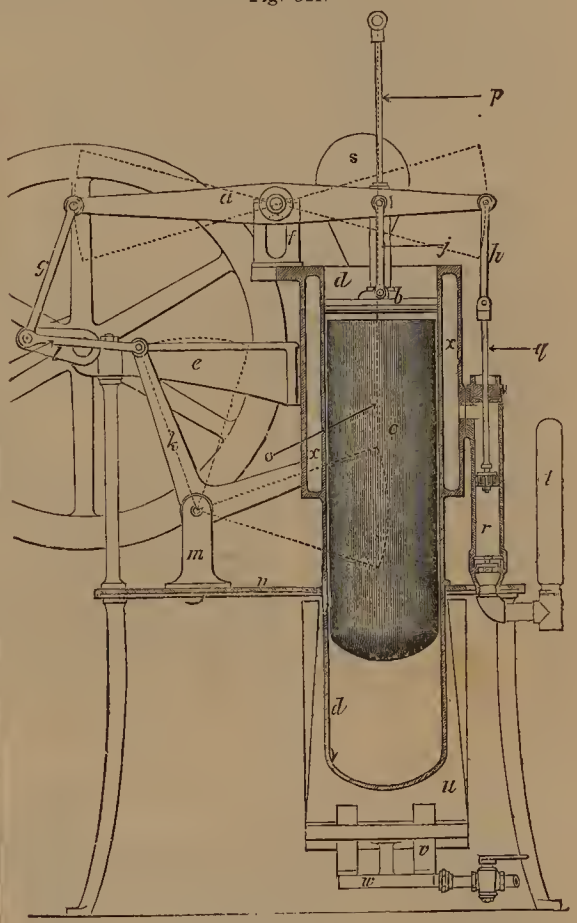
Delamater's Ericsson Caloric Engine. (*Perspective View.*)

engine pump and furnace. The engine is specially intended for domestic use in lifting and forcing water from wells and cisterns, or from city mains, to tanks on upper floors of buildings.

No steam is employed, and any kind of fuel will answer for this engine, but coal-gas is preferable, the consumption being 15 cubic feet per hour for average house use.

The action of the engine is to alternately heat and cool the air confined below the air-piston *b* in cylinder *d*, the heating of the air generating a pressure which acts on the air-piston, causing it to move through its upward stroke, actuating the pump *r* and fly-wheel by means of beam *a* and links *j h g*. The momentum of the fly-wheel and contraction of the air cause the return stroke. The office of the transfer piston *c*, by its movement derived from the crank through link *l* and bell crank *k*, is to displace the air from the lower or heated part of the cylinder *d* to the upper or cold part, and *vice versa*.

Fig. 511.



Delamater's Ericsson Caloric Engine.. (Sectional View.)

u is the gas furnace, *t* the vacuum cylinder, *x* the water jacket, *e* fly-wheel bracket, *f* beam center bearing.

The Brown caloric engine has the furnace separated from the working cylinder, has valved connections between the two, and uses the hot air expansively. The inlet and outlet valves operate independently of each other. The furnace is supplied with coal by a cut-off bottom hopper while the machine is in motion

The steam siren fog signal at the Centennial was operated by one of these engines. See FOG TRUMPET.

Compound, *Beaumont*, Br.	* "*Scientific Amer.*," xliii. 385.
Brown	* "*Manuf. & Builder*," x. 97.
	* "*Eng. & Min. J.*," xxvi. 349.
	* "*Iron Age*," xx., Dec. 6, p. 1.
Ebert	* "*Scientific Amer. Sup.*," 1412.
Roper	* "*Manuf. & Builder*," xi. 177.
Van Renne's	* "*Sc. American*," xxxix. 307.
"Tom Thumb"	* "*Sc. American*," xlii. 373.
Pumping engine, *Ericsson*	* "*Manuf. & Builder*," xii. 150.
Wilcox	* *Laboulaye's* "*Dict.*," etc., iv., article "*Air Chamber.*"
Compression engine, *Rider.*	* "*Polytechnic Review*," ii. 195
	* "*Am. Artisan*," No. 12, 1874.

Cal'o-rie. The amount of heat required to raise

the temperature of 1 kilogram of distilled water 1° Centigrade; about equal to 2.2 pounds raised 1.8° Fah.

Cal'o-rim'e-ter. An instrument for measuring the quantity of heat given out by bodies in passing from one temperature to another.

For *Reynault's*, see *Laboulaye's* "*Dictionnaire*," etc., article, "*Chaleur Spécifique*," tome iv., ed. 1877.
For sugar, * *Ibid.*, vol. iii., Figs. 75, 76, article, "*Sucre.*"

Hare's	* "*Scientific Amer. Sup.*," vii. 2527.
Ericsson's	* "*Scientific Amer. Sup.*" iii. 1103.
Liquid "*Les Mondes*," .	"*Scientific Amer.*," xxxviii. 185.
Violle, Fr.	* "*Scientific American*," xli. 53.
Massachusetts Inst. . .	"*Scientific American*," xxxv. 164.

Cal'va-ri-an Hook. (*Surgical.*) A post-mortem hook, used, as its name indicates, in working upon the skull.

Ca-ma'cho Bat'te-ry. (*Electricity.*) A perfluent battery in which the cells are arranged in steps. The exciting liquid (solution of bichromate of potassium) is contained in a reservoir, and conducted from cell to cell by means of siphons.

Niaudet, American translation	* 231.
"*Engineer*"	* xlii. 203.
"*Scientific American Supplement*" . . .	* 749.

Cam'ber-ing Ma-chine'. A machine for giving a vertical curve to a railway rail. Such rails are used at the summits and feet of inclines and at the junction of grades of varying inclination.

Also used to curve a rail to such a degree that it will be straight when cooled.

See Figs. 8, 9, and pp. 372, "*Engineering*," xxix.

Cam Cut'ter. A special machine-tool made to cut and finish cams of all curves up to 5″ diameter. It is made with either single or double heads. The carriage for reception of the blank is gibbed to the bed, and has sufficient traverse toward or from the cutter-spindle to cut to any required depth. The cones of the cutter-spindles carry 2″ belts. The feed is by worm and gear, and has variable speeds. Machines are built for cutting either periphery and face or periphery alone.

Cam'el. (*Hyd. Eng.*) A float for raising a vessel.

Ships over shoals.
Clark & Standfield, Br. . . * "*Engineering*," xxiii. 370.
See, also, Depositing Dock; Dock; Floating Dock, "*Mech. Dict.*," *et infra.*

Cam'el's Hair Pen'cil. A small brush used by artists, the tuft being made of the hair of the camel. Similar brushes of differing degrees of elasticity are made of fitch, badger, squirrel, goat, and sable.

Cam'e-o Cut'ting. In the process of cameo-cutting the method in Italy is as follows: —

The shell is first cut into pieces the size of the required cameo by means of diamond dust and the slitting mill, or by a blade of steel fed with emery and water. It is then shaped into a square, oval, or other form on the grindstone, and the edge finished with oil stone. It is next cemented to a block of wood, which serves as a handle to be grasped by the artist while tracing out with a pencil the figure to be cut on the shell. The pencil-mark is followed by a sharp point, which scratches the desired outline, and this again by delicate tools of steel wire, flattened at the end and hardened, and by files and gravers for the removal of the superfluous portion of the white enamel.

The cameo cutter selects from the shells which possess the three layers: (1) those which have the layers strongly adherent to each other; (2) those in which the middle layer is thick; (3) those in which there is a good distinction of color between the layers; and (4) those in which the inner layer is of the color suited for his purpose.

The central layer forms the body of the relief, the inner layer being the ground, and the outer the third or superficial color, which is sometimes used to give a varied appearance to the surface of the figure.

See, also, article in "*Scientific American*," xlii. 69.

A fictitious cameo is made from lava or from steatite. In the case of the latter, after the cutting is finished the cameos are inclosed in an air-tight crucible, heated at a reddish glow for several hours, and allowed to cool slowly. They are then flint-hard. Color is given by immersion for several hours in dyes, — saffron, gumboyl, campeche, dragon's blood, etc.

Cam'e-o Glass. Glass cut in imitation of cameos.

Cups and bowls for this purpose are formed of an inner body or layer of dark blue glass, with an outer coating or layer of even thickness of opaque white glass, in which the design is wrought by carving or grinding down to the dark-colored sub-layer, or foundation. This outer white layer is about $\frac{1}{8}$″ thick, and is chiseled in high relief, in a similar manner to that by which the Portland Vase in the British Museum was formed, and also the Pompeiian Vase in the museum at Naples. It is a difficult task to get glass mixtures that have exactly the same degree of shrinkage on cooling. The two differently colored pastes must shrink exactly alike, or cracking would result, especially when the outer layer is chiseled away in forming the design. — *Blake.*

Cam'e-o In'crus-ta'tion. (*Glass.*) A figure, say a small porcelain bust, is introduced into a small cylinder of glass, which is then closed upon it.

Cam'e-o Press. A small screw-press for giving a convex roundness to photograph portraits. The bed and platen are in cameo and intaglio respectively, and the object is pressed between them.

Cam'e-ra. A chamber used in obtaining pictures. See p. 433, "*Mech. Dict.*"

Enlarging, *Edwards* .	* "*Scientific American Sup.*," 2079.
Field	* "*Scientific American Sup.*," 2506.
Lucida, *Hofmann*, Fr. .	* "*Scientific American*," xxxix. 181.
	* "*Scientific American Sup.*," 2243.
	* "*Scientific Am. Sup.*," 2505, 2507.
Multiplying	* "*Scientific American Sup.*," 455.
Obscura, *Kellett* . . .	* "*Scientific American Sup.*," 212.
Obscura	* "*Scientific American Sup.*," 2505.
Obscura, sketching . .	* "*Manufact. and Builder*," ix. 1.
Photographic, *Basham*	* "*Scientific American*," xxxix. 73.
Portable	* "*Scientific American Sup.*," 2506.

Cam'e-ra Lu'ci-da. A glass prism, attached to the eye-piece of a microscope. Described and shown at Fig. 1043, p. 434, "*Mech. Dict.*" The instrument shown at Fig. 512 has a lens to magnify the pencil point; a very important adjunct in making drawings of microscopic objects.

Fig. 512.

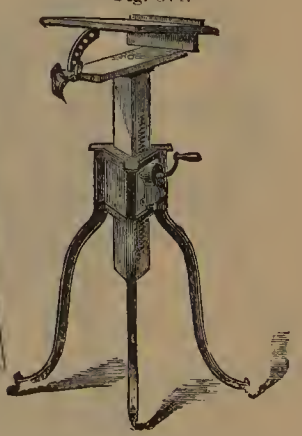
Beck's Camera Lucida.

Cam'e-ra Ob-scu'ra. The camera obscura shown at Fig. 1044, p. 434, "*Mech. Dict.*," was for a long time but little more than a toy. Though its development into the photographic camera now removes it far from this criticism, yet it has only lately been adapted in a worthy way to its original use: the throwing of an image on a piece of paper, to facilitate making sketches, drawings, and views.

Fig. 513.

The Camera Obscura.

Fig. 514.



Bowditch's Camera Stand.

The camera obscura, shown in Fig. 513, has a reflector and a lens, by which the magnified image is thrown upon the paper in the camera, the only light entering at that point. A curtain at the back of the draftsman occludes other light. The lens is in a sliding tube, which may be raised or lowered to adjust the focus. The height of the box must not be less than the focal length of the lens. The mirror is hinged to adjust its direction.

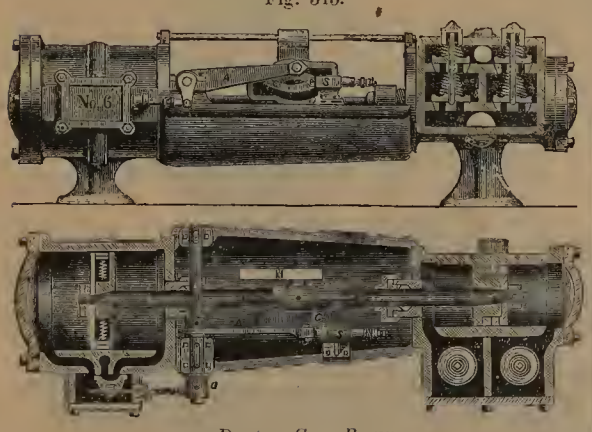
Cam'e-ra Stand. A table to support the photographic camera, having adjustments for height and inclination.

Cam Loom. One in which the harness is operated by cams instead of by pattern chain, jacquard, or other device.

Cam Press. One in which the action of the punch or shear is due to the rotation of a cam: as distinct from a screw, lever, or pendulum press.

Cam Pump. A steam pump, the motions of which are obtained by the media of cams; as distinct from other mechanical means.

Fig. 515.



Dayton Cam Pump.

In the case illustrated in Fig 515, the steam valve is a plain slide valve, worked by means of a cam bolted on the piston-rod, and moving with it, and by the shape of the cam the stroke is slowed down at each end, giving ample time for the water cylinder to fill, and water valves to close before the return stroke. This insures a full stream every stroke, and prevents the pump piston from striking against the water when the cylinder is but partly filled, it being impossible for the steam valve to be thrown into such a position as to shut off steam and stop the pump.

Cam'py-lom'e-ter. An invention of M. Gaumet. A pocket instrument capable of giving at one reading the metric length of any line, straight or curved, on a map or plan; and the natural length corresponding to the graphic length on maps, with a scale of one 80,000th or one 100,000th, or multiples or submultiples of these scales.

"*Manufacturer and Builder*," xii. 157.

Ca-nal'. See following notices:—

Bude in Cornwall	"*Sc. Amer.*," xxxv. 340.
Darien, *d'Aoust*	"*Technologiste*," xl. 389.
Du Midi. Fr.	"*Sc. Amer.*," xxxv. 55.
Florida ship	"*Sc. Amer.*," xxxix. 293.
Inter-oceanic	"*Sc. Am. Sup.*," 2752.
Obi & Jenissei, *Sidoroff*	"*Technologiste*," xl. 291.
Suez, history of	"*Sc. Amer. Sup.*," 93.
U. S. Consul Farman's Rept. on	"*Sc. Amer.*," xl. 240.
Bridge, Blackburn, Engl.	* "*Sc. Am. Sup.*," 1729.
St. Petersburg, *Momma*	"*Technologiste*," xli. 606.
Tug, steam, *St. Clare Byrne*	* "*Sc. Amer. Sup.*," 44.
Works, Soonkêsala Canal, India	* "*Van Nostrand's Mag.*," xv. 385, 481.
Boat elevator, *Clark & Duer*, Eng.	* "*Sc. Amer.*," xlii. 402.
Boat propulsion, *Legouge*	* "*Sc. Amer.*," xxxiv. 278.
Boat propeller (jet), *Bugbee*	* "*Sc. Amer. Sup.*," 89.
Boat propulsion, *Hetzler*	* "*Manuf. & B.*," xii. 128.
Lift, hydraulic, Br.	"*Engineering*," xxi. 227.
Lock working, *Marq. Caligny*, Fr.	* "*Watson's Vienna Expos. Rept.*," iii. 64.
Lock, Aubois, Loire, *Watson*	"*Van Nostrand's Mag.*," xix. 85.
Locks, Barrage of the Nile	* "*Engineering*," xxi. 41.

Hydraulic canal lift at Anderton on the river Weaver: Paper read before the "Institute of Civil Engineers" (London), by Mr. Duer. Reproduced in "*Sc. Am. Sup.*," 295.

Canal-boat lift by caisson and inclined plane, from Potomac River to Chesapeake and Ohio Canal, by William R. Hutton. "*Proceedings of Am. Soc. of Civil Engineers.*"

The invention of M. Girard for avoiding a part of the waste of water in the descent of a boat from a superior to a lower level, is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," Paris, 1877, cap. "*Écluse.*"

Can'al-ic'u-lar In'stru-ments. (*Surgical.*) For operating upon the lachrymal duct.

Jaeger bistoury caché.
Beaumont's concealed canalicular knife.
Greenslade's concealed canalicular knife.
Agnew's canalicular knife.
Petit's Fistula lachrymalis knife.
Lachrymal canula, etc.

Page 10, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*" See, also, CANALICULAR SCISSORS, *a* Fig. 4672, p. 2054, "*Mech. Dict.*"

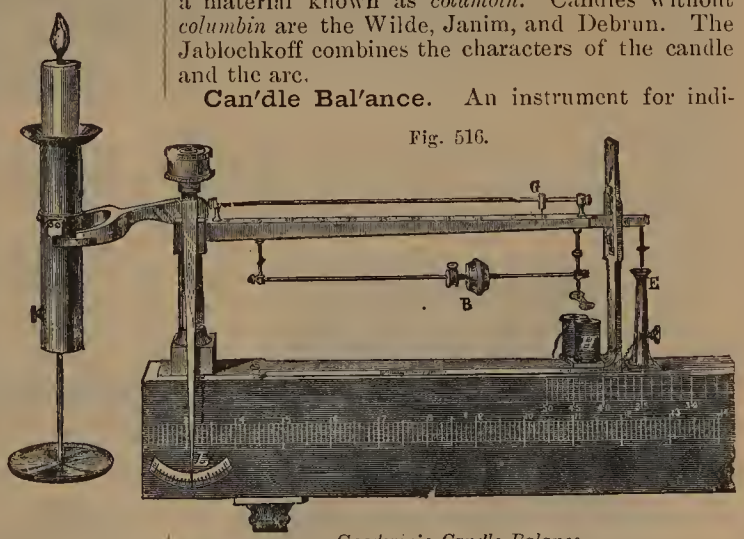
Can Bod'y Form'er. (*Sheet Metal Working.*) A machine for forming the bodies of cans. The locks for the seams being first formed on the blanks, and they placed in position, a single movement of the lever presses the former into the mold and two hinged side-pieces spring forward and clasp the ends of the blank around the back of the former.

Can'dle. (*Electricity.*) An arrangement of carbons in an electric light. The carbons are placed parallel, and as the waste of the two must be equal, they are fed by alternating currents. See ELECTRIC CANDLE.

The Jablochkoff electric light is the most noted of the class; in this the carbons are separated by a material known as *columbin*. Candles without *columbin* are the Wilde, Janim, and Debrun. The Jablochkoff combines the characters of the candle and the arc.

Can'dle Bal'ance. An instrument for indicating when a candle has consumed a set amount of the material of which it is composed.

Fig. 516.



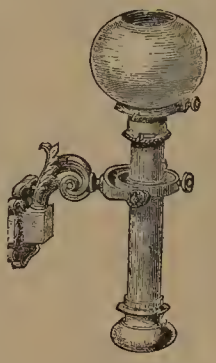
Goodwin's Candle Balance.

The instrument is shown in Fig. 516, *G* being at zero, the weight, *B*, is made to counterpoise the candle. The weight, *G*, being then shifted to the mark indicating the amount to be consumed, the candle is lighted. When the amount is consumed, the balance-lever falls, an electric circuit is completed at *E*, and the armature is drawn to the magnet *H*.

"*American Gas-light Journal*" . . * July 3, 1876, p. 6.

Can'dle Lamp. A lamp, the stem of which holds a candle forced upward by a coiled spring. Used in railway cars and traveling carriages.

Fig. 517.



Candle Lamp.

Can'dle-mold'ing Ma-chine'. A candle-molding machine, made by Wunchmann of Leipzig, was shown at the Centennial Exhibition, 1876.

It is constructed of iron, and designed for molding either paraffine, stearine, or tallow candles.

The molds, 100 in number, stand in two double rows in a close cast-iron box, where they are made steady in the upper and lower walls, but so that they can be taken out, one by one, with ease.

Each of the molds is a tubular structure open at both sides. In it moves a piston that constitutes the mold for the apex of the candle, and is itself attached to a slender iron tube. At the lowest stage the piston shuts the somewhat conically shaped mold close and tight.

All the pistons are secured to a frame by means of long slender tubes, and are raised and lowered simultaneously, by a crank, pinion, and notched bar.

In the lower part of the machine is the wick-box, which can be closed. It contains a hundred wick spools, the wicks passing through the box-cover into a piston tube traversing the piston itself, but by means of a simple contrivance shutting it up so closely that the liquid mass cannot permeate.

Above the two troughs that inclose the double row of molds at the top, is an apparatus called the *clasper*, that serves the purpose of holding the candles on their being raised from the molds. It can be turned on hinges back over to the side of the machine till it rests against two supports. It is opened and shut by means of small levers and eccentrics. There is a simple attachment to centralize and hold fast the wicks immediately over the molds.

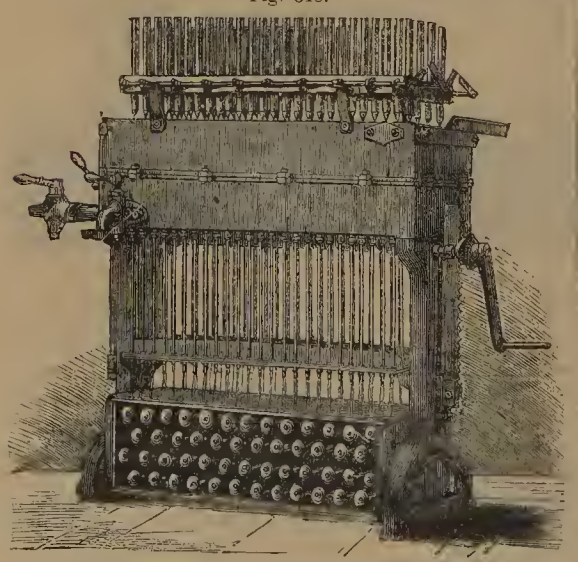
The procedure in operating is as follows: When the wicks have been introduced, they are in the first instance made fast to a little piece of wood laid crosswise over the clasper. The centralizing apparatus is then applied, and steam is admitted into the compartment containing the molds, which are thus quickly heated by its playing around them. The liquid is then admitted into both troughs, and the mold thus filled.

The centralizing apparatus is then withdrawn, and cold water introduced into the compartment.

As soon as the liquid surface over the molds has become sufficiently firm, it is cut off by a shovel adapted for the purpose. When the candles have cooled they are raised out of the molds by turning the crank, and draw the wick from the spools along with them. The candles pass through the open claspers, and, on reaching the highest stage, are there made fast. The crank is then turned backward till the pistons shut up the lower ends of the molds. In due time the wicks are cut and the candles removed.

The cut, Fig. 518, shows the candles in raised position, as held by the claspers.

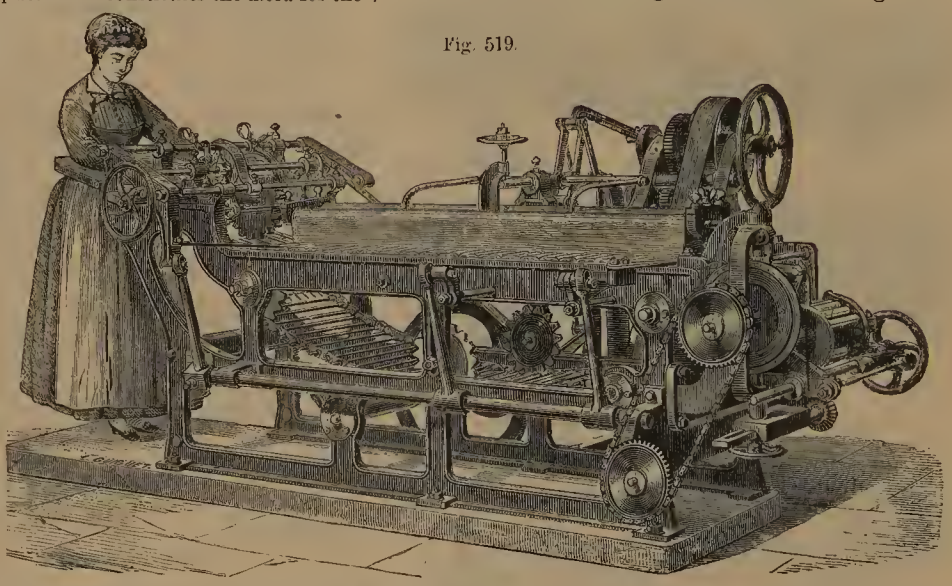
Fig. 518.



Wunchmann's Candle-molding Machine.

Can'dle Pol'ish-ing Ma-chine'. Fig. 519

Fig. 519.



Machine for Clipping, Polishing, and Marking Candles.

shows a machine made by *Morane*, of Paris, for clipping to a length, polishing, and marking candles. The saw and pad, which are concerned in the length, the polisher, and the marker, are all adjustable.

A French polishing machine for candles is shown in Fig. 274, article "*Bougies*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome i., ed. 1877. The candles on an apron pass beneath a succession of rollers.

Can'dle-pow'er Jet Pho-tom'e-ter. An instrument for measuring the light of a burning gas-jet.

Fig. 520.

English Candy-rolling Machine.

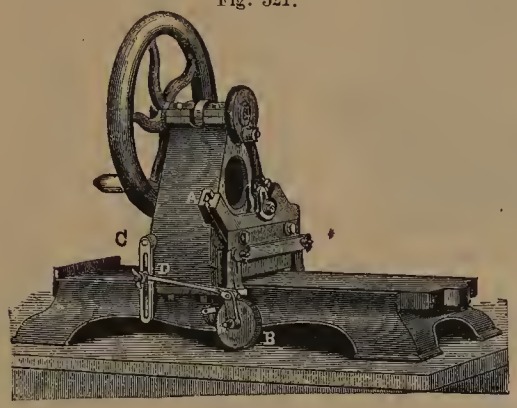
Goodwin's, "American Gaslight Journal," * July 3, 1876, p. 6.

See JET PHOTOMETER.

Can'dy-roll'ing Ma-chine'. A machine with various patterns of rollers for stamping candy in sheets. The pan is $8\frac{1}{4}''$ wide, and each roller is provided with lever and clutch wheel, so that any one can be thrown in or out of gear instantly, without affecting the work of the others.

Can'dy Sli'cer. A guillotine machine for cutting candy into strips or blocks.

Fig. 521.



Candy-slicer.

The cutting-knife is raised and lowered by means of a crank-wheel, and a shearing motion is imparted by the inclined guides *A*. The carrying bed has a rack, and is moved forward by the action of a pinion-wheel on a shaft which carries at its outer end the ratchet-wheel, *B*, operated by a pawl attached to an arm, *D*. The outer end of this fits in a slot in a vibrating arm, *C*, up and down which it is adjusted to regulate the width of the candy slices.

Cane Cul'ti-va'tor. An implement made for the Cuba and West India market, with three broad, round-nosed flat shares, and an expansible frame.

Cane Cut'ter. See CANE MILL.

Cane Knife. An implement for cutting sugar-cane. It varies in different countries and provinces, from the shape of a butcher's cleaver to that of a broad-sword. See MACHETE.

Fig. 522.

Cane Knives. Louisiana Pattern.

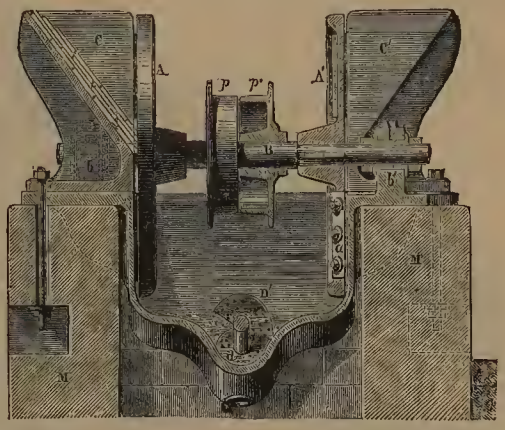
Cane Mill. The French process of *Philippe* is a departure from the ordinary, consisting in cutting the cane into thin slices with a machine, submitting them to levigation in water in a trunk in which a lifting screw rotates, and pressing them in a rotary eccentric press. See also Mignon & Rourt, "*Technologiste,*" xxxviii. 81.

The Figs. 523, 524, 525 show the three stages of the operation, the two latter being, in fact, consecutive, but detached for convenience of illustration in limited space.

The cane cutter of Philippe is shown in Fig. 523, and consists of two root-cutters, composed of cast-iron disks, *A A'*, keyed upon the same axis, *B*, furnished with a fixed pulley, *p*, which communicates the movement, and a loose pulley, *p'*, which receives the belt when the motion of the cutters is to be stopped.

The axis *B*, turns in brass boxes in the pillow-blocks *b b'*, cast with a cistern, *D'*, which receives the sliced cane from the cutting-mill, and which serves at the same time by its

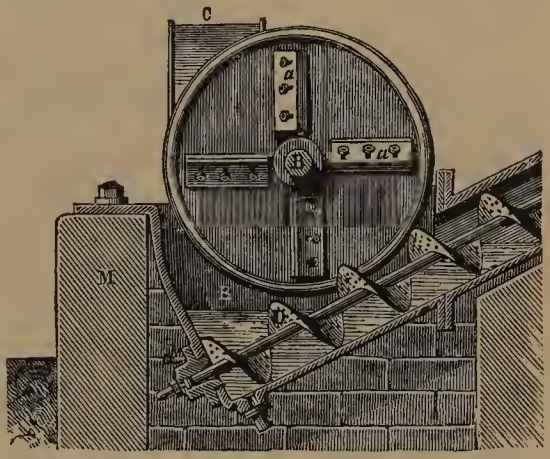
Fig. 523.



Cane-cutting Mill.

large extent to afford a seat for the elevating screw. The whole is bolted to the stone columns in masonry *M*, in

Fig. 524.



Cane-cutting Levigator.

common with the two hoppers *C C'*, into which the cane is thrown by armfuls.

Four slicing-knives *a*, are fixed on the face of each disk, inclined in their seats like the bits of planes.

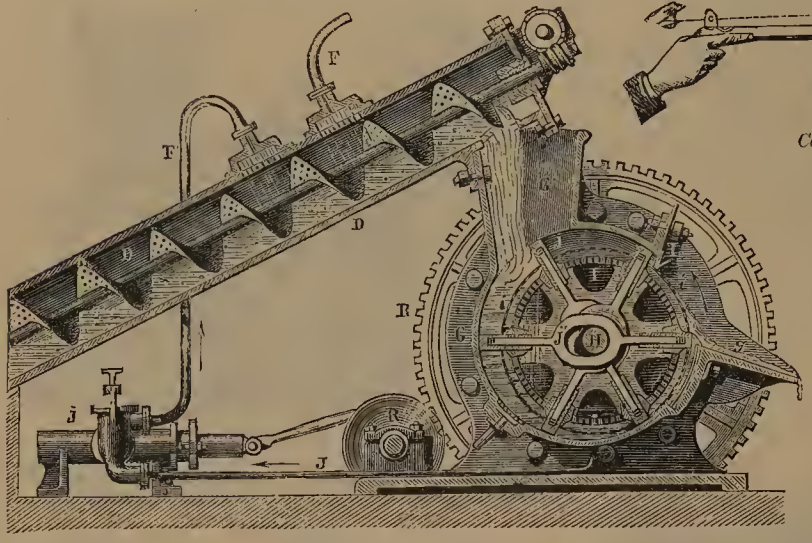
The slices of cane obtained by the action of the cutters, and arriving at the bottom of the cistern, are subjected to levigation. The bottom of the cistern corresponds in shape with the Archimedean screw *D*, the lower end of which revolves in a step, *d*, with an adjusting screw, while the upper end rotates in a brouze collar in the cap which closes the upper end of the inclined cylinder of translation. The endless screw receives rotation from a helicoidal gear whose axis carries the pulley *E*. On the top of the inclined trunk are two boxes which cover the orifices by which the liquid arriving by the pipes *F F* is distributed in the interior over the blades of the screw.

The endless converger is, so to speak, the instrument of levigation of the slices which readily traverse the trunk inclosing the screw, imbibing the liquid and undergoing osmosis more or less complete. When the slices arrive at the summit, they fall into the hopper *G* of the rotary press, which consists of a cylindrical shell *G*, cast with a bed-plate, and with ends in which are bearings of the arbor, *H*, on which is keyed the hollow drum *I*, which is eccentric with the shell *G*.

The pressing is done by six palettes of bronze, *j*, carried by the drum, which catch the mass of slices from the hopper and carry them into a more and more confined space between the drum and the concave shell, finally arriving at the discharge spout *g*, placed at that part of the envelope where the slices escape from the point of greatest pressure.

The drum *I* is cast iron, and its periphery is pierced with a multitude of small openings leading to parallel circular channels covered with perforated steel plates, so that the juice expressed from the slices escapes into the interior of the drum from whence it is discharged laterally at an opening in the central vertical line. Thence is taken by a pipe, *J*, and pump, *j*, and elevated, to be poured again by the pipe *F'* into the trunk where the elevating screw operates.

Fig. 525.



Eccentric Cane Press.

The six bronze palettes are cast hollow, and are connected in pairs diametrically across the wheel. Each pair has a yoke in the mid-length, and they slip radially, the ends of the palettes keeping their places against the interior periphery of the concave shell.

The drum *I* turns slowly, the power being applied by a pinion on the axis of the wheel *R* to the spur-wheel *B*.

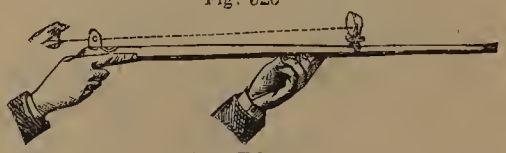
The concentration of the juice is performed by means of a hot-air apparatus, also the invention of M. Philippe, and shown in Fig. 66, article "*Sucre*," in *Laboulaye's* "*Dictionnaire des Arts et Sciences*," tome iii., ed. 1877, to which the author is indebted for the basis of the foregoing account.

The process bears some relation to the Roberts diffusion process, which also employs water to dissolve the sugar of the cane, a substitute for the ordinary cane mill.

Cane-juice bleacher, *Lescale* . * "*Sc. Amer.*," xxxiv. 86.
See also DIFFUSION PROCESS, page 702, "*Mech. Dict.*," *et infra.*

Cane Tel'es-cope. An instrument with seats for the eye and object glasses upon a walking stick. The object-glass is adjustable for focus and may serve as a microscope on occasion. See Fig. 526.

Fig. 526



Cane Telescope.

Can Fill'er. A machine for filling cans with fruit, etc.

In Bucklin's can-filler, tomatoes, — for instance, — which have been previously peeled, are separated from the juice with a sieve, and then go forward into the hopper and roll thence to the gradually tapered end of the cylinder. The can is placed on the rests and is pressed down, which brings the can opening directly opposite the cylinder. The treadle is now brought down and the plunger forces the tomatoes into the can.

Canning fruits, etc., Cutting Co., Cal. "*Sc. Am.*," xli. 148.
Can opener, *Wilson* . . . . . "*Sc. Am.*," xlvi. 307.

Can La'bel-ing Ma-chine'. In Bigelow's labeling machine, the can is placed at the head of the incline; rolling down which it passes over a padded roller rotating in a reservoir of paste, and thence over the label, taking it up as the pasted surface on the can adheres to it, rolling itself in it.

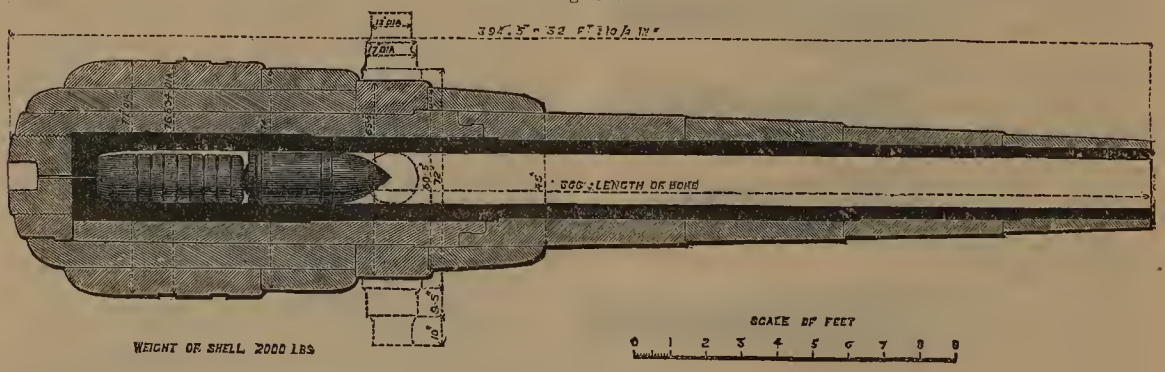
In passing down, the can strikes a lever which by its connection with a second reservoir pastes one end of the next label, at the same time acting on the feed screw and raising the labels the thickness of one.

Can'nel. 1. (*Weaving.*) A style of weaving; making a corded or rep tissue.

2. A variety of coal: *candle-coal*, highly bituminous.

Can'non. The cannon shown in Figure 527 is

Fig. 527.



Armstrong 100-*ton Gun.*

one of eight made by Sir W. G. Armstrong & Co., of Elswick ordnance works, Newcastle-upon-Tyne, for the Italian government, to be placed on board the turret-ships "Duilio" and "Dandolo." One of these ships was built at Spezzia and the other at Castellamare, and each is of 7,000 tons burden. The gun is made on the well-known Armstrong principle, having 27 grooves and as many bands of about equal width. The rifling is an increasing spiral on the parabolic development, winding up with a twist of 1 in 45 calibers. The depth of the grooves is $\frac{1}{8}''$ throughout. See p. 158, "*Mech. Dict.*"

The weight of the gun is 227,360 pounds.
Extreme length, 32′ 10½″.
Length of bore, 30′ 6″.
Diameter of bore, 17″.
Outside diameter of gun: muzzle, 29″.
Outside diameter at breech, 77″.

The barrel is in two pieces made into one in the building up. There are three layers of coils over the thickest end of the gun.

The weight of the projectile is 2,000 pounds.
Work developed at the muzzle, 39,000 foot pounds.
Velocity 1,400′ per second.
The loading gear is hydraulic.

Albini . . . . . * "*Sc. American Sup.*," 2734.
America's contribution to modern artillery . . . "*Sc. American*," xxxix. 353.
Armstrong . . . . . "*Sc. American Sup.*," 1125.
100-ton, Br. . . . . * "*Engineer*," xlii. 102.
"*Iron Age*," xvii., June 1, p. 1.

Armstrong	* "*Engineer*," xlviii. 255. *Laboulaye's* "*Dict.*," iv., article "*Boulets.*"
	"*Engineer*," xliii. 355.
	"*Engineer*," xlix. 187.
	* "*Engineer*," xliii. 355.
Woolwich	* "*Engineer*," l. 225. "*Sc. Am. Sup.*," * 759; * 614; * 1314; 4073.
81-ton	"*Iron Age*," xvii., Jan. 6, 11. "*Engineer*," xlii. 183. "*Engineering*," xxi. 536. "*Sc. Am. Sup.*," lv. 760.
Trials, 80-ton	* "*Sc. Am. Sup.*," 1046. * "*Engineer*," xlii. 235. "*Iron Age*," xix., May 24, 16.
Trials	* "*Sc. Am. Sup.*," 1237.
Tests	* "*Engineer*," xliii. 73, 91, 317.
Woolwich	* "*Engineer*," xlix. 187.
9.2″-gun. Woolwich	* "*Engineer*," xlix. 453.
40-ton, *Armstrong*	"*Van Nostrand's Mag.*," xvi. 478.
38-ton carriage, Br.	* "*Engineer*," xlii. 411.
38-ton, Engl.	"*Sc. American*," xxxv. 324. "*Sc. Am. Sup.*," 501.
12-pounder, field, Br.	* "*Engineer*," xlii. 251.
Mountain, *Armstrong*	* "*Sc. Am. Sup.*," 254.
13-dr field-piece, Br.	* "*Sc. Am. Sup.*," 4087.
"Duilio," bursting of	"*Sc. American*," xlii. 272.
Blakeley	* "*Engineer*," l.
Elephant	* "*Sc. Am. Sup.*," 2534.
Elsurck, 39-ton br.-loader	* "*Engineer*," xliii. 200.
38-ton. Target, etc.	* "*Engineer*," xliii. 200.
Essen, making at	"*Iron Age*," xxiv., Aug. 21, 3.
Eastman	* *Laboulaye's* "*Dictionnaire*," etc., iv., art. "*Boulets.*"
Gautier, Cast Steel	"*Sc. Am. Sup.*," 1543.
Heavy	"*Sc. Am. Sup.*," 2698, 2735.
Hotchkiss revolver	* "*Sc. Am. Sup.*," 735.
Illuminating Shell	* "*Sc. American*," xxxvii. 79.
Italian, 100-ton	"*Iron Age*," xxii., July 4, 18.
Working, SS. "Italia"	* "*Engineer*," xlvii. 153.
Albini, Ital.	* "*Engineer*," xlvii. 156.
Tests 100-ton, Spezzia	* "*Engineer*," xlii. 445, 448.
And targets	* "*Engineering*," xxii. 426, 431. * "*Sc. Am. Sup.*," 982. * "*Engineer*," xliii. 1.
Johnson, Br. loading attach.	* "*Sc. American*," xl. 230.
Breech-loading field gun	* "*Sc. Am. Sup.*," 1968. * "*Engineering*," xxiv. 443.
Krupp and Woolwich	"*Van Nostrand's Mag.*," xxii. 172.
Krupp, Works	"*Sc. Am. Sup.*," 638.
Field	* "*Engineer*," xlviii. 121.
Making	"*Iron Age*," xx., Nov. 29, p. 5.
Construction	"*Sc. American*," xl. 250.
126-ton	"*Iron Age*," xvii., Apr. 6, p 7.
72-ton	"*Van Nostr. Mag.*," xx. 522. "*Iron Age*," xxiii., M'ch 27, 7.
71-ton } Meppen 52-ton } and others (20 figs.)	* "*Engineer*," xlviii. 119, 128.
16″ gun	"*Sc. Am. Sup.*," 2580.
14″ gun, mounted	* "*Engineering*," xxiii. 44.
14.5-ton	* "*Engineer*," l.
Heavy	* "*Sc. American Sup.*," 2656.
Masked	* "*Sc. American Sup.*," 931.
Protected non-recoil	* "*Engineer*," xliv. 295.
Br.	* "*Sc. American*," xxxvii. 371.
Mode of working heavy	* "*Engineer*," xlvii. 24.
Line throwing, *Eggers & Pierce*	* "*Sc. American*," xl. 150.
Maquay breastwork	* "*Sc. American*," xxxvii. 200.
Moncrieff carriage	"*Sc. American Sup.*," 76.
Mott, submarine	"*Sc. American Sup.*," 2015.
Mule-back. Jointed for	"*Sc. American*," xxxix. 40.
Palliser, Br. Breech-loader,	* "*Engineer*," l. 361. * "*Engineer*," xlix. 169.
Powerful	"*Sc. American*," xli. 265.
Prussian field-gun	*Laboulaye's* "*Dict.*," etc., i., article "*Bouche à feu.*"
Russian, heavy	* "*Engineering*," xxiii. 179.
Carriages, cyclads	* "*Engineer*," xivii. 336.
Foundry	"*Iron Age*," xix., May 24, 19.
Span. navy breech-loading	* "*Engineer*," l. 79.
Steam gear for, Br.	"*Van Nostrand's Magazine*," xviii. 286.
"Thunderer," Br. Exploded	* "*Engineer*," xlvii. 244. * "*Engineer*," xlviii. 45.
Sister of expl. gun, Br.	* "*Engineer*," xlix. 97, 117, 153, 261. * "*Sc. American*," xli. 130.
Uchatius, Aust. Bronze steel	* "*Sc. American*," xxxvii. 403. "*Sc. American Sup.*," 1299. * "*Engineer*," xliv. 255.
Vavasseur, 13.5-ton	* "*Engineer*," l.
Whitworth	*Laboulaye's* "*Dictionnaire*," etc., iv., article "*Boulets.*"
Woodbridge, Apparatus for measuring pressure	* "*Engineer*," xlvii. 134, 170.

Dean's field-piece made by a peculiar process for condensing and hardening the metal of the bore; "*Ordnance Report*," * 1877, Appendix S.

See also FIELD-PIECE.

Thompson's 12″ breech-loading rifle gun, "*Ordnance Report*," 1876, Plate I., p. 96.

Sutcliffe 9″ breech-loading rifle, *Ibid.*, 1876, p. 108.

10″ *Rodman* converted to 9″ rifle *Ibid.*, 1876, p. 134.

10″ *Rodman* converted to 8″ rifle. *Ibid.*, App. K, p. 142.

Woodbridge 10″ rifle, breech-loader. *Ibid.*, 1876, Appendix N, Plates I. to XI.

Illustrated Papers on construction of rifled cannon.

11″ m. l rifle, converted from 15″ Rodman. "*Report of Chief of Ordnance*," 1879, * p. 61.

3″ b. l. rifle. *Ibid.*, 1879, * p. 67.

3.16″ m. l. rifle. *Ibid.*, 1879, * p. 71.

3.17″ m. l. rifle. *Ibid.*, 1879, * p. 73.

4.5″ b. l. rifle. *Ibid.*, 1879, * p. 77.

"*Report on the Manufacture of Life Saving Guns.*" *Ibid.*, 1879, * p. 270, with 7 plates.

Frazer System (British), Cols. Barnard and Wright's report, U. S. Engineer Dept., 1871, pp. 84-90.

Krupp, system compared. *Ibid.*, p. 90 *et seq.* Plates XIX - XXI., and p. 102.

Krupp, breech loading field-piece. *Ibid.*, Plate XXXI., p. 104.

Krupp, brecch loading heavy guns. *Ibid.*, Plates XXII:-XXV.

Muzzle-pointing-gun carriages. *Ibid.*, page 182 *et seq.*

Frazer, 35-ton gun. *Ibid.*, * Plate XXXVI.

Moncrieff carriages. *Ibid.*, * Plate XXXVII., p. 200. App. XI.

Moncrieff, hydro-pneumatic carriage. *Ibid*, * p. 215. App. XII.

Cf. Butler's "*Projectiles and Rifled Cannon.*"

Benton's "*Ordnance and Gunnery.*"

Holley's "*Ordnance and Armor.*"

Can'non Car. (*Railway.*) *a.* A car especially constructed for transporting heavy pieces.

b. A car with carriage for mounting a gun, and usually provided with a screen for the gunners.

Can'non Re-vol'ver. See MACHINE GUN; GATLING GUN; GUNWALE GUN.

Ca-noe'. The canoe "Maria Theresa," designed by Rev. Baden Powell of England, built by E. Waters & Sons, of Troy, N. Y., and rowed by N. H. Bishop of Lake George, N. Y., from the Gulf of St. Lawrence to Gulf of Mexico, has the following dimensions: —

Length, 14′.	Weight of Canoeist, 130 lbs.
Beam, 18″.	Weight of outfit, 90 lbs.
Depth amidship, 9″.	Total weight, 278 lbs.
Weight, 58 lbs.	

Cruising	* "*Sc. Am. Sup.*," 2607.
Fijeau	* "*Sc. Am. Sup.*," 1778.
Folding, *Berthon*, Br.	* "*Engineer*," xlvii. 333.
Folding, *Berthon*	* "*Sc. Am. Sup.*," 2873.
Life boat, "Evangelist," Australia.	* "*Sc. Am. Sup.*," 1778
Racine	* "*Sc. Am.*," xlii. 231.
Steam, "Nina"	* "*Sc. Am.*," xl. 142.

See, also, BOAT.

Cant. (*Saw-milling.*) A log slabbed on two sides and ready to turn down to be sawed the other way.

Cant'ing Ta'ble. In a band sawing machine a table capable of inclination so as to present the stuff to the saw in such position as to saw beveling. Such a table is shown in Fig. 553, p. 226, "*Mech. Dict.*"

Cant Splice. (*Nautical.*) A loop splice; also known as *cut* splice. See *k n*, Fig. 5435, p. 2279, "*Mech. Dict.*"

Ca-nu'la. (*Surgical.*) A tube. Its uses are various, and construction adapted to special purpose.

The references are to *Tiemann's* "*Armamentarium Chirurgicum.*"

The epistaxis canula of *Belocq*, Fig. 246, Part II.

Gooche's canula for ligating hemorrhoidal tumors; a

double canula for conducting the ligature to a deep-seated part, the loop projecting at the end. Fig. 592, Part III.

Lachrymal canula, Fig. 57, Part II.

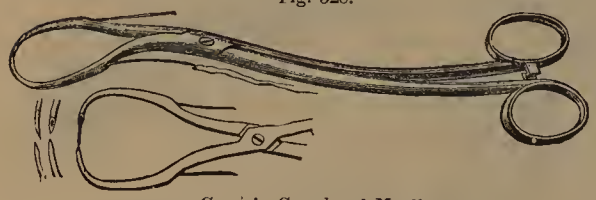
Nasal polypus canula, double like the hemorrhoidal just cited, Fig. 245, Part II.

Double canula and obturator, Fig. 389, Part II.

Tracheal canula for preserving an opening in a divided trachea, Fig. 331, *b*, Part II.

Can'u-la-ted Nee'dle. (*Surgical.*) A hol-

Fig. 528.



Currie's Canulated Needle.

low needle which affords a passage for the ligating wire or thread throughout its length. Such is *Tiemann's* hollow needle for wire sutures, in which the silver wire passes through the length of the handle and issues near the needle-point.

Currie's double canulated needle is a means of introducing a wire or silk. The views show it closed and open. Being closed upon the opposite edges of a wound, for instance, the wire is passed through the canal, issuing at the opposite member of the instrument. The upper figure shows a mode of drawing through a silk by means of a fine flexible hook.

Caout'chouc. An elastic gum obtained from the siphonia, ficus, urceola, etc., of South America and tropical Asia.

See the following references: —

Cf. Articles, manufacture of, *Longden.*
* "*Scientific American,*" xxxvi. 150.
Factory and machinery * "*Scientific American,*" xliii. 15.
* "*Eng. & Mining Journal,*" xi. 1.
Gathering and manufacture.
Bolas . . . . . * "*Scientific American Sup.,*" 3958.
* "*Scientific American Sup.,*" 3991.
* "*Scientific American Sup.,*" 4008.
Gathering and preparation.
"*Scientific American Sup.,*" 2288.
Uses and manufacture.
Pavoux . . . . . * "*Van Nostrand's Mag.,*" xiv. 369.
Manufacture . . . . * "*Scientific American,*" xxxv. 262.
* "*Scientific American,*" xxxix. 105.

Caout'chouc Ar'ti-fi'cial. To a thick solution of glue add tungstate of soda and hydrochloric acid. A compound of tungstic acid and glue is precipitated which, on cooling, may be drawn into sheets.

Caout'chouc Ce-ment'. Pulverize shellac; soften in 10 times the quantity of ammonia. This will become liquid in time, and will dissolve the surface of caoutchouc, rendering it easy to unite it with glass.

Caout'chouc Sol'vents.

Of the solvents of caoutchouc, its distillate caoutchoucine may be placed at the head of the list: the others best known are pure chloroform, carbon disulphide, rosin, oil, and coal naphthas, rectified oils of turpentine, gutta-percha, tar, lavender, sassafras, ocoten, rosemary, amber, ambercupion, terebene, benzine — C_{12} H_6 — hydrochlorate of terebene, benzole — C_{14} H_6. Anhydrous oil of turpentine dissolves 49 per cent. of caoutchouc. A mixture of 6 to 8 per cent. of absolute alcohol and 100 of carbon disulphide is an excellent solvent. Sulphuric ether, which alone is but a poor solvent, dissolves rather more, if about 5 per cent. of anhydrous alcohol be added thereto. Hot alcohol dissolves out about 4.712 per cent. of a soft resin. It is sparingly soluble in hot fused oil — hydrate of amyl C_{10} H_{11} HO; readily at a gentle heat in melted hog's lard, or in very hot whale oil. After swelling up in oil of turpentine or in naphtha it is soluble in hot linseed oil.

Cap. (*Add.*) 14. (*Fire-arm.*) The metallic covering placed on the end of a pistol-shaped handle.

15. A short terminal section of a pipe, with a removable stopper called a *plug.*

16. (*Mining.*) *a.* A vein is "*in the cap*" when it is much contracted.

b. A flat piece of wood placed between the top of the punch and the roof of the mine.

17. (*Manége.*) A small crescent-shaped piece of leather placed on top of a collar. Not the *pad* which is sometimes of metal and goes below it on the neck of the horse.

Ca'pel. (*Mining.*) A rock composed of quartz, schorl and hornblende, occurring in connection with tin and less frequently with copper ores.

Cap'il-la-ry Bot'tle. A dropping bottle containing a liquid used in mounting microscopic objects.

Capillary electrometer. . . . * "*Engineering,*" xxiii. 453.
Capillarity Instrument, *Romilly* * "*Sc. Amer.,*" xxxvi. 306.

Cap'per. A tool used in placing the priming cap on its seat in the rear end of the metallic shell.

Fig. 529.

Capillary Battle.

Fig. 530.

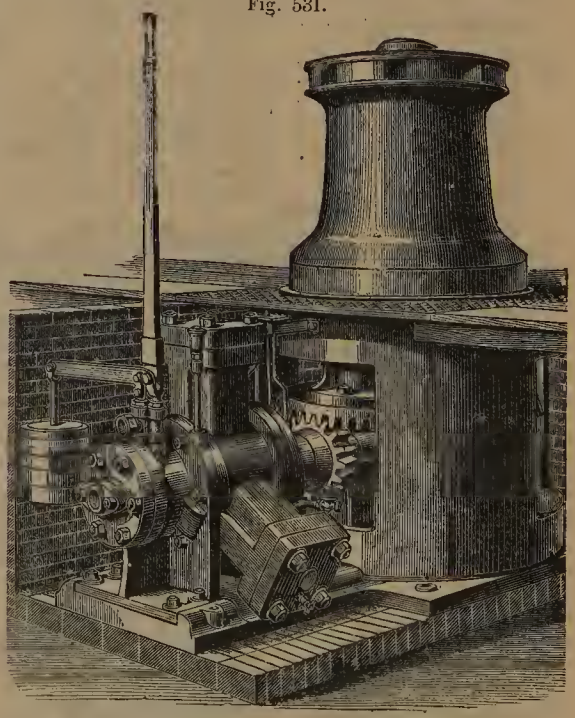
Cap Screw.

Cap Screw. A machine screw with a cubical head, used for screwing on the cylinder head.

Cap Shore. (*Nautical.*) A supporting spar between the cap and the trestle-tree.

Cap'stan. The Brotherhood engine, which has three cylinders, and pistons at 120° working to a common three-throw crank, is especially adapted to direct circular movement and is shown in Fig. 531. It is more direct and less ex-

Fig. 531.



Dock Capstan with Brotherhood Engine.

pensive than the multiple geared hydraulic capstans. In the size shown, the capstan has a capacity for a three-ton pull upon the hawser, the capstan head being 26″ diameter. The engine is reversible. The capstan has sockets for hand-spikes, and is fitted

with pawls for hand work. The lubrication is all from above.

Portable Steam Capstan . * "*Scientific American*," xxxvi. 4.

Cap'stan Knot. (*Nautical.*) A form of knot, shown at 11, Fig. 2777, p. 1240, "*Mech. Dict.*"

Cap'sule. A cover, cap, or sac. The word has many uses; all allied. See page 457, "*Mech. Dict.*"

Filling of Wafer Capsules. . * "*Sc. Amer. Sup.*," 1484.
Capsuling medicines, *Limousin* * "*Sc. American*," xxxiv. 259.

Car. A wheeled vehicle. Specially: a railway carriage.

Bullet proof . . . . . "*R. R. Gazette*," xxi. 181.
Coal, Penusylvania Railway . * "*R. R. Gazette*," viii. 149.
Rhenish Railway, Ger. . . * "*Engineering*," xxx. 430.
4-wheeled, N. Y. Central . * "*R. R. Gazette*," viii. 391.
Composite Bogie, *Festiniog*, Br. * "*Engineer*," xlix. 338.
Director's, Penn. Railway . . * "*Engineering*," xxiv. 460.
Dump, *Davis* . . . . . * "*R. R. Gaz.*," xxii. 489.
Elevated, Metropolitan, N. Y. * "*Sc. Amer.*," xxxix. 310.
Freight, on construction of, Br. "*Van Nostrand's Mag.*," xvi. 135.
W. Railway of France . . * "*Engineering*," xxix. 30.
Austrian State Railway . . * "*Paris Exp.*," 1878, iv. 448.
Gravel, Penn. Railway . . . * "*Engineering*," xxiv. 469.
Iron, *Kellogg & Seaver* . . . * "*R. R. Gaz.*," xxiii. 43.
Painting, paper by *Robertson* . "*Sc. Amer.*," xxxix. 357.
Passenger, E. Railway of Fr. . * "*Engineering*," xxvi. 69.
1st class, E. Railway of Fr. . * "*Engineer*," xlvi. 278.
3d class, E. Railway of Fr. . * "*Engineer*," xlvi. 314.
1st class, Austrian State Ry. * "*Paris Exp.*," 1878, iv. 447.
2d class, Austrian State Ry. * "*Paris Exp.*," 1878, iv. 448.
3d class, Austrian State Ry. * "*Paris Exp.*," 1878, iv. 448.
Eastern Railway of France . * "*Engineering*," xxvi. 192.
1st class, W. Railway of Fr. . * "*Engineer*," xlix. 160, 248.
* "*Paris Exp.*," 1878, iv. 446.
3d class, W. Railway of Fr. . * "*Engineering*," xxxvi. 406.
Western Railway of France . * "*Engineering*," xxx. 22.
Bogie, Buenos Ayres R. R. . * "*Engineer*," xliv. 220, 224, 238, 246.
Western Railway of France . * "*Engineering*," xxvii. 341.
Composite, W. Railway of Fr. * "*Engineering*," xxvii. 433.
2d class, W. Railway of Fr. * "*Engineering*," xxviii. 170.
Southern Railway of France * "*Engineering*," xxvii. 230.
Pennsylvania Railway . . * "*Engineering*," xxiv. 404, 458.
Cost of . . . . . * "*Sc. American*," xli. 209.
Saloon, S. W. Railway, Br. . . * "*Engineer*," xlv. 111.
6-wheeled truck, Midland R. R. Br. . . . . * "*Railroad Gaz.*," viii. 368.
Sleeping, Austrian State Ry. . * "*Paris Exp.*," 1878, iv. 448.
Door fastener, *Buser & Shaw* . * "*Sc. Amer.*," xlii. 179.
Grain door, *Susemihl & Miller* * "*R. R. Gaz.*," xxiii. 481.
Van Lieuw. . . . . . * "*R. R. Gaz.*," xxiii. 411.
* "*R. R. Gaz.*," xxi. 527.
Hibbert . . . . . * "*Sc. Amer.*," xliii. 226.
Lock, *Jelly & Jones*, Br. . . . * "*Engineer*," xlviii. 206.
Maxwell, Br. . . . . * "*Engineer*," xliii. 293.
Lamp, *Westinghouse*, N. Br. Ry. * "*Engineer*," xlvii. 388.
Lamp step . . . . . "*R. R. Gaz.*," xxiv. 264.
Lighting, *Westinghouse* . . . * "*Engineering*," xxvii. 264.
Spring tester, *Riehlé's* . . . * "*R. R. Gazette*," xxii. 64.
Seat spring, *Delessert*, Fr. . . * "*Engineering*," xxx. 196.
Seat, *Heywood* . . . . . * "*R. R. Gazette*," xxi. 200.
Starter, *Pritchard's* . . . . * "*Min. & Sc. Pr.*," xxxvi. 1.
Hansell's . . . . . * "*Sc. American*," xliii. 99.
Step, *Skerritt* . . . . . * "*Sc. American*," xli. 414.
Window, *Deblois* . . . . . * "*Sc. Amer.*," xxxix. 168.
Mackall . . . . . * "*Sc. American*," xlii. 195.
Flexible blind, *Wilson* . . . * "*R. R. Gazette*," xxii. 184.

For varieties of ear-lamps, see *Forney's* "*Car Builder's Dictionary*, p. 94.

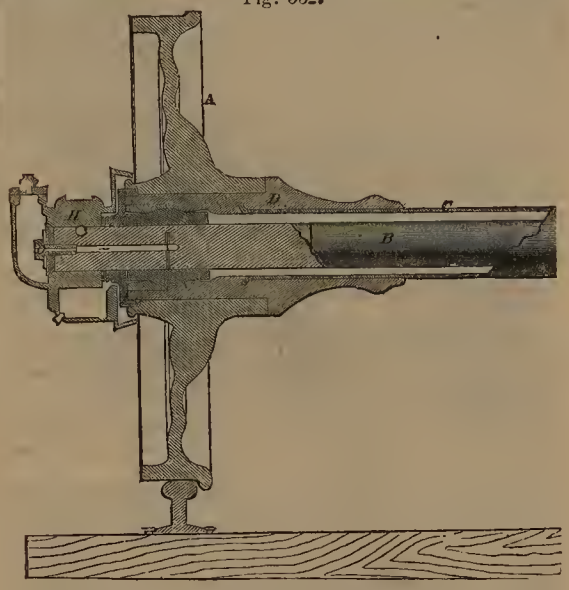
Car Ax'le. At the Centennial Exhibition (1876) were shown several axles which had for their object to allow the wheels of each pair to revolve independently of each other.

In the *S. L. Harrison* axle, each wheel is fixed to a sheath which extends to the center of the axle, and which revolves with the wheel to which it is attached, upon the axle.

The *Auchinloss* axle is divided in the middle, and there held in place by a sleeve about two feet long, in which the parts can revolve separately. In this case each wheel revolves with its own half of the axle.

"The axle of the *Miltimore Car Axle Company* was applied to one of the trains running in the Centennial grounds, and with a notable diminution of the friction in passing round the very sharp curves on this railway. In the construction of the Miltimore axle, the wheel *A* is mounted on, but not fixed to, a sleeve, *C D*, which revolves round the fixed axle *B*, upon which the car rests; the sleeve being kept in place by the axle boxes *H*, which are fixed to the main axle; the

Fig. 532.



Miltimore Car Axle.

wheel *A* can, moreover, revolve round the sleeve *D*, when, by reason of a curve or inequality in the road, one wheel is required to move with more rapidity than the other." — *Capt. Galton.* See, also: —

Standard . . . . . * "*R. R. Gazette*," xxiii. 555.
Frame . . . . . * "*R. R. Gazette*," xxii. 133.
Tests, *Chamberlain* . . . . * "*Scientific Am. Sup.*," 1793.
Boxes, European, on, *Browne* * "*R. R. Gaz.*," xxii. 389, 399.
Tomlinson . . . . . * "*Scientific Am. Sup.*," 1875.
Trunnion, *Hill* . . . . . * "*Scientific Am.*," xxxix. 358.
Journal bearing, *Pullman* . * "*R. R. Gazette*," xxi. 443.
Journal box cover, *Hewitt* . * "*R. R. Gazette*," xxiii. 448.

Car'bo-az'o-tine. An explosive: —

Nitrate of potassium	61.04
Sulphate of iron	0.73
Lampblack	24.65
Sulphur	13.58
	100.00

Car-bol'ic Ac'id Pa'per. Used for packing fresh meats, in order to preserve them.

Prepared by melting 5 parts stearin at a gentle heat, and then stirring in 2 parts carbolic acid, and afterwards 5 parts melted paraffin. The mass is well stirred until cool, and is then applied with a brush to the paper.

Paper saturated with other tar or petroleum products is also used for defending clothes, furs, etc., from moths or ants. U. S. Patents 88,519; 105,160; 94,357.

Car'bon-a-ta'tion Pan. (*Sugar.*) *Carbonatation* is the saturation of the defecated beet-juice with carbonic acid gas.

"The carbonatation pans in which the defecated and the scum juices are treated, are furnished at the bottom with a pipe, pierced with three parallel rows of small holes, $\frac{1}{8}$" in diameter, through which the carbonic acid is forced into the liquid. There are also coil pipes or double bottoms, for heating by steam while the process is going on. When foaming has ceased, the carbonated juice is drawn off into large receivers or settling tanks, where it is allowed to settle, after which the juice is ready for the filters, unless, as is often done, it is subjected to a second carbonatation. In many works, the carbonic acid gas is produced from the calcination of limestone, instead of the combustion of charcoal.

"In the *Perier & Possoz* process of defecation and carbonation, the milk of lime which is used must be finely divided through a close metallic sieve, and must contain two per cent. of lime, indicated by 10° on Beaumé's areometer. One measure of this solution is gradually added in eight or ten successive additions, to every forty measures of the juice which is to be operated on. During this the temperature of the juice is raised from 188° to 158° Fah. Carb.-acid

gas is now turned into the juice, while it is being stirred, and at the same time a small stream of milk of lime is continuously fed into it. This lime is quickly dissolved and precipitated, carrying down with it most of the coloring matters and the impurities contained in the liquid. The proper moment for arresting the carbonatation is indicated by a chemical test of the juice. When this point is reached, the juice is drawn into settling tanks and allowed to settle for about twenty minutes. From these tanks it is run into a second set of defecating pans, where more lime is added. The carbonic acid is at once turned on, and continues to flow into the juice until complete saturation is effected, which is known by a chemical test, nearly the same as before. The juice is now brought to the boiling point, to drive out the free carbonic acid, and is then run into a second set of settling tanks. In these tanks it remains until it has cleared itself sufficiently, when it is ready to be conveyed to the charcoal filters for further treatment.

"In *Jelinck's* process, defecation and carbonatation are simultaneous, and terminate in a single operation, instead of two successive ones, as in the previous method.

"The pans which are used are furnished with a carbonic acid coil-pipe, and are deeper than the ordinary defecating pans. The juice, as it is admitted to them, is comparatively cold, and must never exceed a temperature of 140° Fah.

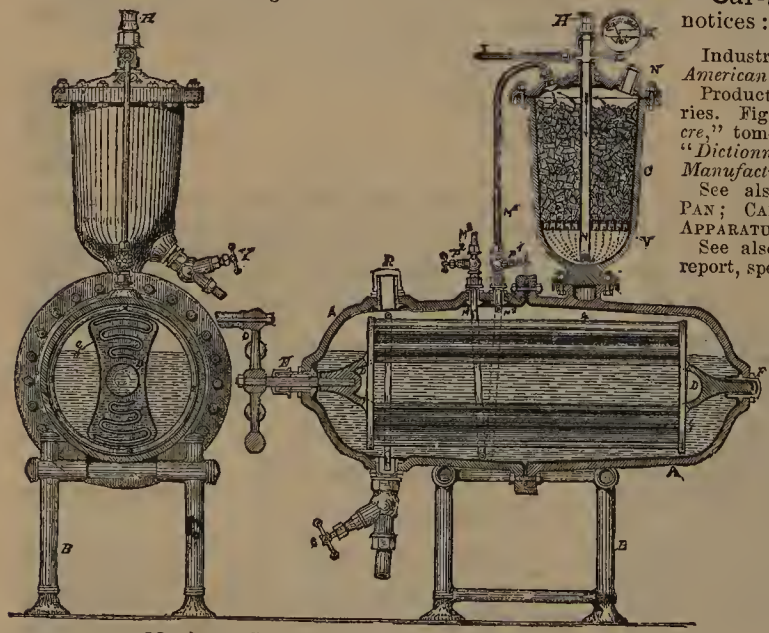
"At least two per cent. in weight of lime is added to the juice, in the shape of milk of lime; and carbonic acid gas being admitted, the heat is gradually increased until the precipitates form rapidly and fall to the bottom.

"This process is based on the theory of acting on cold juice at first so as to produce a solution of saccharate of lime, out of which the carbonic acid gas precipitates the lime as carbonate of lime, which carries with it a certain amount of organic matter, freeing at the same time, the sugar, which recombines with a portion of the lime, to be again freed by a second decomposition of the saccharates and a consequent precipitation of carbonate of lime, and so on for an indefinite number of times during the period of a single operation."

Car'bon-a'ted Bev'er-age Ap'pa-ra'tus. Apparatus for impregnating liquids with carbonic acid gas.

In the apparatus, Fig. 533, a corrugated agitator is employed in a stationary fountain. The beaters *G* are of tinned copper attached to a tinned bronze frame, and the bearings

Fig. 533.



Matthews' Corrugated Agitator.

E F and the agitator itself are covered with tin to avoid contamination of the beverage. The agitator is revolved by the handle *O*, which passes through the stuffing box *E*. The corrugated beaters carry up the liquid into the gas space and also submerge the gas in the liquid, bringing the two into intimate contact and causing the rapid absorption of the gas by the water. See also pp. 2235-2237, "*Mech. Dict.*"

Aërated water machinery, *Hayward, Tyler & Co.*, Br. * "*Engineering*," xxvi. 287, 349.

Car'bon-a'ted Stone. An artificial stone in which carbonic acid and steam are used artificially as re-agents in the composition. The object is to hasten the carbonation beyond that incident to the exposure to the air, by exposing the compound sand and cement to an atmosphere of carbonic acid and vapor of water.

Car'bon-ates. (*Mining.*) *Soft carbonates;* salts containing carbonic acid, with a base of lead. *Hard carbonates:* the same, with iron for a base.

Car'bon Bat'te-ry. (*Electricity.*) One in which carbon replaces the copper element.

The original and most important of this class is that of BUNSEN, which see. See also FAURE BATTERY, see also *Jablochkoff*, "*Technologiste*," xl. 3; LECLANCHÉ BATTERY.

Car'bon Bronze. An anti-friction alloy invented by Baldwin & Weisman. Its basis is copper, and it is made in Pittsburg. See —

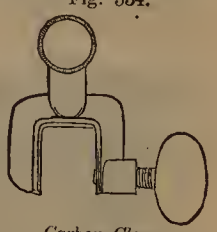
"*Iron Age*" . . . xvii., May 4, p. 24; xxii., Sept. 19, p. 23.
"*Mining and Sc. Press*," xxxviii. 227.

Car'bon But'ton. A variety of lamp-black compressed by a screw press in steel dies to form a disk about $\frac{1}{16}''$ long and $\frac{1}{2}''$ diameter. It is used as a portion of an electric circuit, as an electrical resistance. In practice it is placed in a small case, into which is dropped a little disk faced with platinum. Contact is made at the top and bottom with wire. It may be adjusted to any resistance within the range of its own limit which may be chosen. The limits may be varied also by the pressure employed in making the carbon button. If the pressure be increased the sensitiveness of the button is very materially augmented. — *Edison.*

See CARBON TELEPHONE.

Car'bon Clamp. (*Electricity.*) The metallic connector for the carbon element in the battery. It is screwed to the carbon, and a binding screw affords attachment for the wire. See Fig. 534.

Fig. 534.



Carbon Clamp.

Car-bon'ic Ac'id. See the following notices: —

Industrial uses of. * "*Sc. American*," xxxiv. 386.

Production of, for sucreries. Fig. 40, article "*Sucre*," tome iii., *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877.

See also CARBONATATION PAN; CARBONATED WATER APPARATUS.

See also Dr. McMurtrie's report, special, No. 28, U. S. Department of Agriculture.

Car'bon In'di-ca'tor. See CARBON TESTING INSTRUMENT; CARBUROMETER; FIRE-DAMP DETECTOR; GRISOUMETER, etc.

Car'bon-i-za'tion. The carbonization of wool and woolen cloth, as is commonly called, is a misnomer; it is the vegetable refuse which is found in the wool of Australia and South America, which is carbonized as a means of removal from the animal fibre.

See article from "*Textile Manufacturer*," reproduced in "*Scientific American Supplement*," vi. 2335.

See also SEPARATOR, 5, p. 2094, "*Mech. Dict.*"

Carbonization of coal for the production of illuminating gas is considered under GAS, COKE, etc. See also apparatus on p. 2292, * "*Scientific American Supplement.*"

See also CHARCOAL FURNACE, . . * p. 527, "*Mech. Dict.*"

Hugon's furnace for conservation of wood by carbonizing the surface. * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877, article "*Conservation des bois.*"

Carbonization pits for charcoal, * *Ibid.*, tome i., article, "*Carbonization*," Figs. 367-370.

See also COKE FURNACE, GAS AND COKE FURNACE, *infra*, and COKE OVEN, Fig. 1384, p. 593, "*Mech. Dict.*"

Car'bon Pro'cess. (*Photography.*) A photo-

graphic process in which prints are obtained in carbon, either in lamp-black or in ink. See CARBON PROCESS, p. 461, "*Mech. Dict.*"

Braun's Carbon Process (Dornach, Alsace-Lorraine). The method is as follows: A negative is obtained by the ordinary collodion process. Paper covered with a mixture of gelatine, coloring-matter, and bichromate of potassium is exposed to light behind the negative. On removal from the copying-press, a layer of caoutchouc is placed on the gelatine. This is then washed in lukewarm water, and the paper and part of the gelatine thus removed. When the remaining gelatine is dry, it is attached to the paper backing by means of a thin layer of gelatine spread on the latter, and the caoutchouc is dissolved off by benzine. Most beautiful carbon prints are thus obtained. The process requires nice manipulation and great care, but does not necessitate an outlay for presses and their appurtenances.

Obernetter's process (Munich). This is very similar to that of Albert (p. 57, "*Mech. Dict.*"). The first part, viz: the preparation of the two coatings, is almost identical. After the exposure behind the negative, however, Obernetter covers the gelatine with impalpable zinc-powder, and then heats it in an oven to 200° C. The plate is then subjected to the action of dilute hydrochloric acid and washed, and it is thus rendered capable of receiving an ink on those parts where no zinc is attached. Obernetter thus obtains a plate from which more impressions can be taken than from even that of Albert. The grain produced in the picture is also of great advantage.

See, also: —

Farguier . . . . . "*Sc. American*," xxxiv. 242.
"*Manufacturer & Builder*," x. 240.
Brit. Jour. of Photography, "*Sc., American Sup.*," 1642.

Car'bon Tel'e-phone. That form of telephone invented by Edison, in which a piece of compressed carbon is placed in a galvanic circuit, the vibrations of the diaphragm causing by pressure variations in the electrical resistance of the carbon, resulting in the production of an undulatory current capable of producing in the receiving instrument sonorous vibrations similar to those which were made at the transmitting end of the wire.

"*English Mechanic*" . . . . . * xxvii. 381.

Fig 535.

Edison's Carbon Telephone.

In Fig. 535, the ferrotype diaphragm of the mouth-piece lies upon *B* which is a piece of rubber resting on an ivory disk, beneath which is a piece of platinum, *D*. The block of compressed or gas-carbon is represented by *E*, and beneath that is a plate of platinum, *G*, with a screw to attach it to the stem. The latter can be advanced or withdrawn by means of the screwed end-piece, so as to bring the ivory disk, and consequently the carbon, with more or less force against the diaphragm.

Car'bon Test'ing In'stru-ment. An instrument for the determination of the relative quantity of carbon in steel. See, also, CARBON INDICATOR, *supra*; and CARBUROMETER, *infra*.

For fire-damp detectors see GRISOUMETER, and references *passim*.

McCreath's analysis app. . . * "*Eng. & Min. J.*," xxiii. 169.
Ryder's magnetic testing instr. * "*Eng. & Min. J.*," xxiii. 27.

Car'bon-zinc Con-nect'or. A binding post used in making the necessary connections between the elements of the galvanic battery.

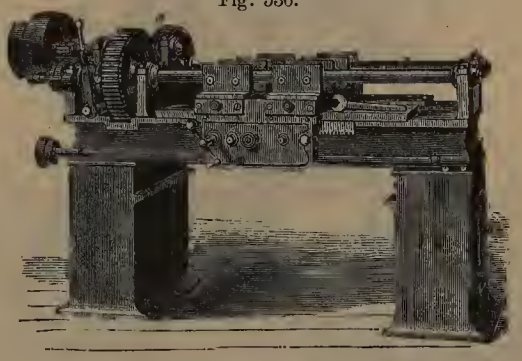
Car-bor'ing Ma-chine'. A boring machine of large size for boring the sills and other timbers of cars.

Such are horizontal, angle, etc. See ANGLE CAR-BORING MACHINE.

Also Fig. 818, p. 341, "*Mech. Dict.*"

Car'-box Bor'ing Ma-chine'. A machine to bore the brass boxes for car axles; it is furnished with two boring bars of steel $2\frac{5}{8}$" diameter, and so arranged that either bar may be used independently of the other. A slide-rest is provided for each bar, and is so arranged that four boxes may be operated upon at the same time, on each rest.

Fig. 536.



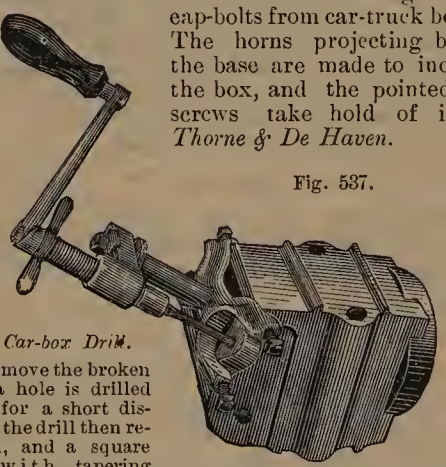
Car-box Boring Machine.

The rests are operated by means of a rod feed; can be used in either direction, or instantly detached and operated with a quick hand movement. The boring-bar is of sufficient length to admit cutters for rounding both ends of the boxes without removing them from their places after being bored.

"*Railroad Gazette*" . . . . . * xxi. 415.

Car'-box Drill. A tool for removing broken cap-bolts from car-truck boxes. The horns projecting below the base are made to include the box, and the pointed set screws take hold of it. — *Thorne & De Haven.*

Fig. 537.



Car-box Drill.

To remove the broken bolt, a hole is drilled in it for a short distance, the drill then removed, and a square drift with tapering edges substituted in the spindle and forced into the hole by the feed-screw, until its edges are slightly imbedded in the bolt. By turning the crank and feed-screw in the reverse direction, the broken bolt will be readily backed out.

See also "*Railroad Gazette*" . . . . . * xx. 75.

Car'-box Grind'ing Ma-chine'. A machine for fitting car brasses by means of an emery wheel turned to the correct circular shape by means of a diamond tool. See Fig. 538.

The brass to be ground is put in a clamp, which is set in planed ways and passed beneath the emery wheel. The detached portions below (*B C D E*) represent parts and boxes in various conditions.

Car'boy. A large globular bottle for acids.

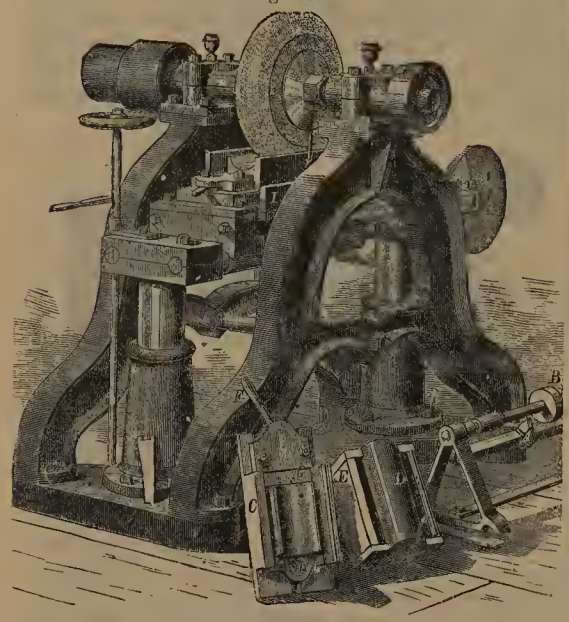
Carboy barrow, Fr. . . . . * "*Sc. American*," xxxix. 322.
Carboy holder, *Laquas*, Fr. . * "*Sc. American*," xxxix. 324.
Carboy pump, *Nichols* . . . * "*Iron Age*," xxii., Sept. 5, p. 9.

Car Brake. See RAILWAY CAR BRAKE.

Car'bu-ret'or. A machine for impregnating with the vapor of a hydro-carbon. Page 464, * "*Mech. Dict.*"

"Alpha" . . . . . * "*Engineer*," xxiii. 69.
Pew & Weart . . . . . * "*Scientific American*," xl. 262.

Fig. 538.



Car-box Grinding Machine.

Car'bu-rom'e-ter. An instrument invented by M. Coquillon for determining the composition of gases contained in fuel, as regards their contents in carbonic oxide, hydrogen, and hydro-carburets.

The general principle of the apparatus is the same as the inventor's GRISOUMETER (which see), (fire-damp detector), the hydrogen and hydro-carbon being determined by means of combustion in contact with palladium wire, while the other constituents are absorbed by special solvents.

"Engineering" . . . . . * xxiv. 317.
"Scientific American Supplement" . . . * 1615.

Car'cel-bec. The French unit of illumination. Given the preference over *candle-power* and the equivalent German and other words, at the Electrical Congress, in Paris, 1881.

Car Coup'ler. A link, hook, or bolt connection between adjacent railway cars.

Miller's arrangement is automatic, and used with his platform. It consists of two heavy iron hooks which act as draw-bars, and are made to engage with each other by springs when the cars come together. See *C C*, Fig. 1607, p. 466, *"Mech. Dict."*

Janney's. The outer end of the draw-bar is made of a forked or U-shape, and to one arm an L-shaped knuckle or clutch is pivoted, so that when the two draw-bars come together the two knuckles engage into each other. A buffing or compressing device, consisting of two buffers, one on each side of the draw-bar, is also used in connection with the self-coupling apparatus described.

Forney's "Car Builder's Dictionary" . . * 364.
"Railroad Gazette" . . . . . * xxiii. 13.
"Scientific American Supplement" . . . * 2619.

English railway-car couplings are considered in a paper by T. Atwood Brockelbank, read before the "Society of Arts," London, 1876; and reproduced in *"Scientific American Supplement,"* * i. 333.

It considers the history of car couplings; cites early methods and patents, and illustrates *Spooner's, Sterne's, Brockelbank's*, etc. See also Fig. 1107, p. 456, *"Mech. Dict."*

"Scientific American Sup.," 513.
Bailey . . . . . * *"Scientific American Sup.,"* 690.
Becker, Austria . . . * *"Engineering,"* xxiv. 424.
* *"Engineer,"* xlii. 444.
Chandler, Br. . . . . * *"Engineer,"* xlviii. 268.
* *"Engineering,"* xxviii. 413.
Douglas, Br. . . . }
Harrison, Br. . . . } * *"Engineering,"* xxv. 182.
Walker, Br. . . . }
Fenwick, Br. . . . . * *"Engineer,"* xlvii. 117.
Harrison, Br. . . . . * *"Engineering,"* xxiv. 493.
Haswell, Vienna . . . * *"Engineer,"* xlii. 220.
Heavener . . . . . * *"Sc. American,"* xxxvii. 198.
King, Br. . . . . * *"Engineer,"* xlii. 145.
Lahaye . . . . . *"Am. Railroad Jour.,"* xlix. 261.
Mawlam, Br. . . . . * *"Engineering,"* xxx. 8.
* *"Scientific American,"* xliii. 131.
Patterson . . . . . * *"Scientific American,"* xxxix. 5.
Peck . . . . . * *"Scientific American,"* xlii. 260.
Buffer, *Turton*, Br. . . * *"Engineering,"* xxx. 568.
Walker, Br. . . . . }
Harrison, Br. . . . } * *"Engineer,"* xlv. 188.

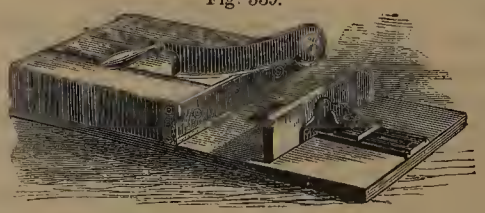
Card'-board Cut'ter. Packer's card-board cutter is designed for cutting card and mill board for paper-box manufacturers, etc., who require material cut in oval and circular forms. The card-board is placed upon a stand in certain positions according to the shape required, and is passed between two disks with knife edges operated by a crank.

See also diagrams of blanks, page 1616, *"Mech. Dict."*

Dickinson's gang card-cutter is composed of two series of circular shears, upper and lower, mounted on iron axes, on which they are adjusted by means of wooden flanges. The shear axes are driven by belt.

Fig. 539 is a wooden frame card-cutter with a pivoted knife cutting against a straight edge. In front is an adjustable gage.

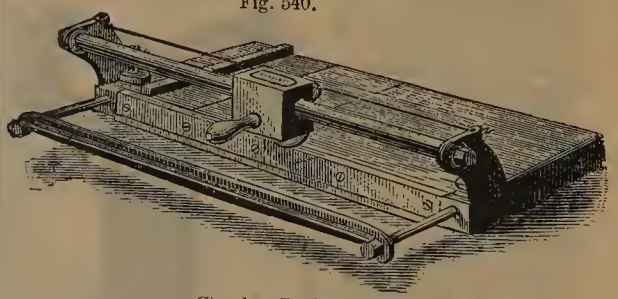
Fig. 539.



Wooden Frame Card-cutter.

Fig. 540 is a rotary card-cutter which has a circular cutting disk traversing against a straight edge. The adjustable gage has a pair of sliding extension rods and set screws.

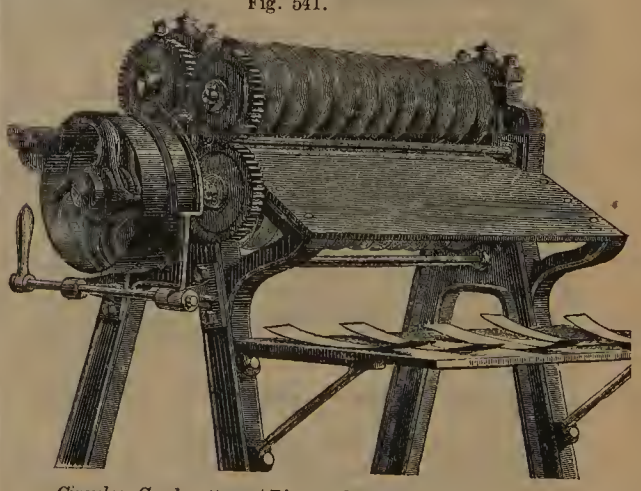
Fig. 540.



Circular Card-cutter.

The machine of Pierron & Dehaitre, of Paris, has gangs of circular knives for cutting card-boards in bands, and the bands into cards.

Fig. 541.



Circular Card-cutter. (Pierron & Dehaitre, Paris.)

It is made to work by hand, foot, or power; is made of capacities to suit the merchant sizes of card-board, and the blades are adjustable in width for the specific sizes of cards required.

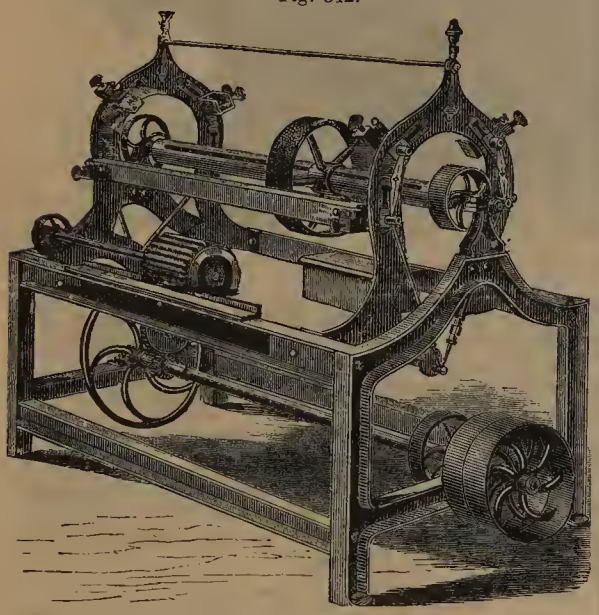
See also Fig. 392, article "*Cartes à jouer*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome i., ed. 1877.

Card'-grind-ing Ma-chine'. A machine for grinding the card clothing of carding machines, to give the shape and sharpness to the ends of the wires.

The card roller or flat is placed in bearings or clamps in the machine, and the grinding wheel traversed back and forth in front of it. The wheel runs clear past the end of the roller or flat, as the case may be, before it stops and commences the backward motion. The traversing grinding roller is held to be an improvement upon a full-length roller, the inequalities of which are repeated upon the card-roller or flat.

Fig. 542 represents the *Hardy* traverse-wheel grinder, for grinding from 1 to 4 top-flats at a time, with a cylinder

Fig. 542.

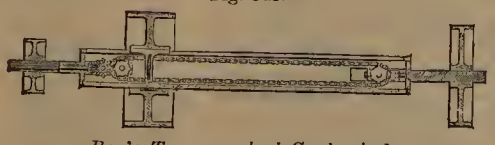


Traverse-wheel Card-grinder.

brush for cleaning out the teeth before the grinding is done perfectly. The motion of the grinding wheel is caused by a screw inside of the slotted and hollow shaft on which the wheels slip and with which it rotates.

Fig. 543 shows Roy's mode of traversing the grinding-wheel; the motion is rapid, the wheel traversing from 10 to

Fig. 543.



Roy's Traverse-wheel Card-grinder.

20 times per minute, according to the length of the card. The motion of translation is by an endless chain and bevel gears inside of the sleeve, which is at the same time the axis of the wheel.

Edwards's mode of clothing the grinding cylinders with emery cloth is described in

"*Scientific American Supplement*" . . . . * vi. 2179.

The grinding machine of *Platt Bros.*, of Oldham, Britain, shown at the Centennial Exhibition, in 1876, was arranged for grinding either two rollers or two clearers at the same time, and for carding-engines both 40″ and 48″ on the wire.

In the most modern construction the machine carries a ventilating fan, and has setting-on apparatus to move the parts to be ground parallel with the emery cylinder; this machine, however, is not adapted for two widths of carding engines.

The machine of *Dobson & Barlow*, of Bolton, Britain, is for grinding rollers and flats, one of each at the same time.

It has a cylinder 12″ in diameter, and can have a fan applied. It occupies but a small space. The flat passes slowly over the cylinder while grinding, and returns quickly, thus saving time in grinding. This is a small-sized machine, but they are made to grind two or more rollers or flats, as required.

In the machine of *M. A. Forbush*, of Philadelphia, the grinding cylinder has an angular thread cut from one end to the other, and the card cylinder rests in bearings on the frame and is revolved by a belt from a pulley on the grinder-shaft. Flour of emery and oil are used, and the shape of the end of each wire on the card agrees with that of the angular tooth.

In the carding machine of *Platt Bros.*, of Oldham, Britain, the card clothing on the flats is ground when the machine is in full work, thus avoiding any loss of time and any necessity for a separate grinding machine.

Car'di-a-graph'. An instrument for recording the beats of the heart. It is usually applied to the chest.

The *sphygmograph*, as its name indicates, is applied to the pulse.

The *pneumograph* and *myograph* are also instruments of research of allied character.

The *sphygmograph* of Dr. Keyt (see SPHYGMOGRAPH) is also capable of being used as a *cardiagraph*, for tracing the action of the heart's apex against the chest wall. The base of the instrument is pressed down upon an intercostal space, at the point of greatest impulse, which is usually between the fourth and fifth ribs.

The cardiac apparatus of *Marey* is referred to in

"*Scientific American*," * xxxvi. 51.

"*Scientific American Supplement*," * i. 117.

Laboulaye's "*Dictionnaire des Arts et Manufactures*," tome iv., article "*Graphiques*," ed. 1877.

The telephone is used in auscultation, for cardiac murmurs and different varieties of respiration ("*Boston Medical and Surgical Journal*") and, it may be added, though not apropos of the chest, that the *microphone* has been used by Sir Henry Thompson in lithotrity to detect by sound the contact of the lithotrite (or sound) with fragments of stone.

See, also, PLETHYSMOGRAPH; CHEILOANGIOSCOPE.

Car-di-am'e-ter. An instrument for measuring the rate or force (or both) of the heart action. See CARDIAGRAPH.

Cammann's cardiameter is an instrument for measuring the distance of the apex beat from the median line. It is of the nature of a compass, with sliding bar and graduated index.

Fig. 273, p. 84, Part I., *Tiemann's* "*Armamentarium Chirurgicum*."

Car'di-gan-jack'et Ma-chine'. A knitting machine adapted to making knit jackets. It is a circular rib machine, making the polka or one-and-one stitch; and the one shown by Gimson & Coltman, of Leicester, England, at the Centennial, had an action by which it could form a welt at any time, according to the length of jacket required. It is fitted with a dial for indicating the length and number of courses made. It will produce in a day 6 dozens of bodies.

See also SLEEVE MACHINE.

Lamb's Cardigan-jacket machine is also adapted for the polka, or one-and-one rib stitch.

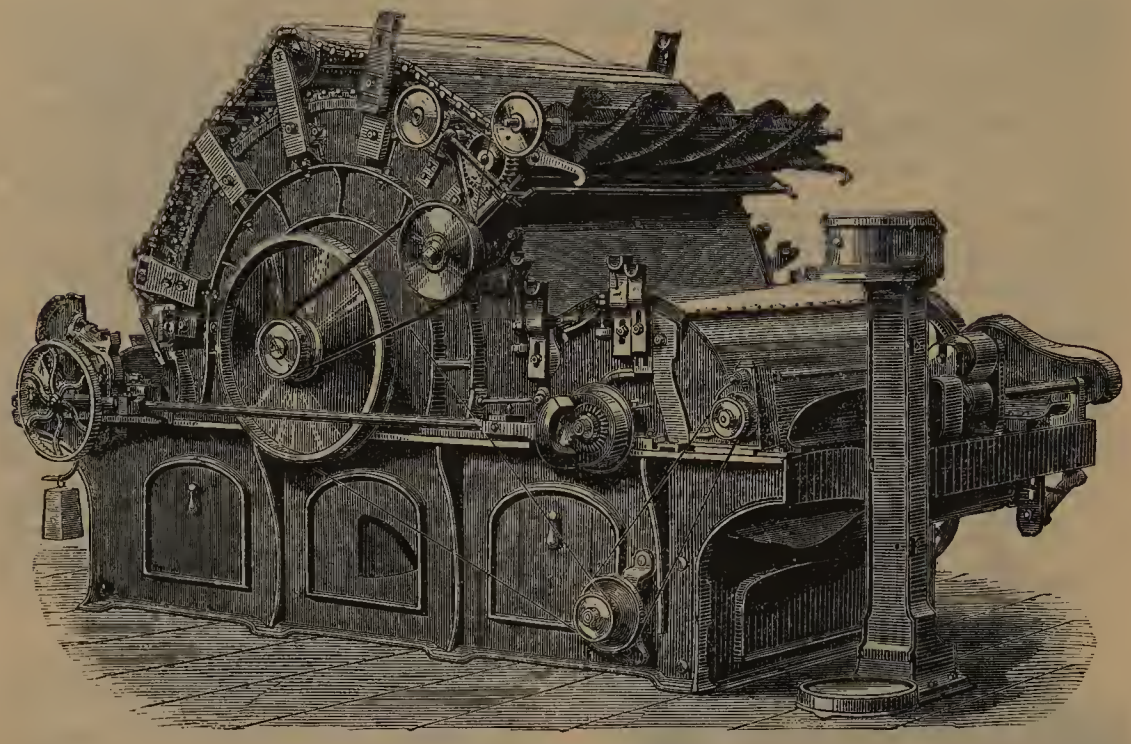
It is described in G. W. Gregory's report on knitting machines. — "*Centennial Reports*."

Card'ing Ma-chine'. The *revolving*, or *traveling-flat* carding machine, exhibited by Dobson & Barlow, of Bolton, Britain, at the Centennial, has a *cylinder* 50″ in diameter, 40″ wide on the wire; *doffer* 24″ diameter, *takers in* 9″ diameter, also 70 iron *flats* 2″ broad, which have been tested by an apparatus which insures perfect accuracy.

The flats travel over the cylinder supported on a flexible iron bend which has 5 adjusting screws, and by this means the flats can always be accurately set at the proper working distance from the cylinder. The machine has fixings for grinding the flats while the card is at work; also for grinding the cylinder and doffer separately. No less than 27 flats are always at work on the cylinder at any time.

The machine has a taker-in with inserted wire, and containing eight separate coils in every inch. This make of

Fig. 544



Dobson & Barlow's Carding Machine.

taker-in is preferred on account of its not being so liable to choke as the ordinary wire, but is always clean, and requires no grinding. This card is also arranged for stripping out the cylinder by power, and has an angular bar casing under the cylinder only, with adjustable plate to and from the doffer, adjustable knife under taker-in, and sheet-iron division between the cylinder and the taker-in, to keep the waste from each separated.

The advantages of this card are, that the flats can be ground on the machine. The fixings for supporting the flats, knives, etc., are fitted on planed surfaces cast with the bends, so that they are not liable to be moved from their proper positions. All the flats are well borne up when not working on the cylinder, so that the person setting them may be able to test their accuracy without difficulty.

The cylinder and doffer can be ground separately at one time, if required.

The composite carding machine of *Dobson & Barlow*, of Bolton, England, has a cylinder 45″ in diameter, 40″ wide on the wire; doffer 22″ diameter, taker-in 9″ diameter, two rollers 6″ diameter, two clearers 4″ diameter, and 16 flats 2½″ wide, stripped in three different ways. The six flats at back nearest the feed roller are stripped three times, the five center ones twice, and the five at front once, thus stripping those flats most charged with waste more frequently than the flats nearest the doffer which are least charged.

This stripper is so arranged that a quick motion is given during the time the flat is being stripped, in order to prevent any collection of fly in its absence from the cylinder. The flat stripper is also cleaned by a top stripper, thus allowing the flat stripper to pass underneath the flat perfectly clean, and without the necessity of touching the wire, except in one direction, and that when stripping the flat.

See also, French carding machine; Figs. 1324–1326, article "*Laines*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., ed. 1877.

In *Platt Bros.* (Oldham, Britain) carding machine, the oiling apparatus for wool is applied under the first burring (steam) cylinder, the oil being supplied to a trough in which a smooth roller works; above this roller, and in contact with it, is another roller covered with cloth, which is also in contact with the burr roller. The oil is taken from the smooth roller by the covered roller, and from the covered roller to the teeth of the burr roller, by which it is imparted to the wool as it passes over the same. The oil is fed regularly to the trough from a cistern by means of a sipbon.

In the triple burr roller arrangement the wire on the first roller is of the coarsest pitch, that on the second of an intermediate pitch, and that on the third roller of a finer pitch; the large burrs, etc., are thrown out by the first guard roller, the intermediate burrs are thrown out by the second guard roller, and the finest burrs by the third guard roller.

Car Gain'ing Ma-chine'. A machine for cutting slots transversely in car timbers or grooves across the face of a beam.

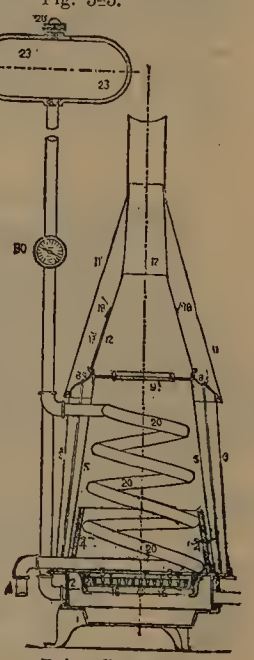
See GAINING MACHINE, Fig. 2144, p. 935, "*Mech. Dict.*"

Car'go Block. A device used in lifting and depositing bales or other packages. It is really a self-detaching hook which disengages itself from the sling of the package as soon as the latter touches bottom, enabling the man at the crane to lower away and detach his hook.

Lawrence's cargo block . * "*Iron*," 1880.
* "*Sc. American Sup.*," x. 4027.

Car Heat'er. In the Baker heater the heat is applied to the car by means of hot water led round the car on the floor level, with bends to carry the pipes horizontally under each row of seats; the water is heated by coiling a portion of the pipe, and passing this coiled portion through a circular iron stove, the fire-box of which is of wrought iron, and inclosed in an envelope of the same material, which terminates at the chimney. The fire is fed by opening a grated lid. Both ends of the pipe terminate in a close cylindrical cistern placed on the roof of the car. A safety-valve is loaded to 150 lbs, and an indicator dial shows the pressure. The liquid used is a saturated salt water. The allowance of

Fig. 545.



Baker Car Heater.

heating surface is 4½′ of pipe per passenger. See also page 484, "*Mech. Dict.*"

The French system of heating cars is by portable hot-water heaters placed on the floors of the cars. The apparatus by which they are expeditiously heated in sufficient numbers at large depots is described in a French report, and reproduced in "*Scientific American Supplement*": * vii. 2815.

Acetate of soda in solution is now used on the Paris, Lyons, & Mediterranean Railway. The substance has great latent heat; being heated, the salt dissolves; in cooling, crystallizes; is again heated to redissolve the crystals.

See, also, FOOT-WARMER.

Simple steam-pipes from the locomotive conducted through the train by pipes. "*Scientific American*," xxxviii. 223.

Heating apparatus . . "*Scientific Amer.*," xxxix. 406.
E. Railway of France *"*Engineering*," xxvi 427.
*"*Engineering*," xxvi. 193.
Stove, *Rice* . . . . . *"*Scientific American*," xl. 86.
Stove, steel-cased . . . *"*Railroad Gazette*," xxiii. 607.
Spear. Forney's "Car Builder's Dictionary," * p. 411.
Baker. Ibid. . . . . . * p. 416.

Ca-ril'lon. 1. A chiming or bell-ringing apparatus; or the chime itself. Page 472, "*Mech. Dict.*"

2. A stand of bells mounted on a frame, and used with brass bands.

In Gillest & Bland's (British) carillon machine described in "*Iron*," and reproduced in "*Scientific American*," the difficulty of keeping correct time, owing to the different power required to drive the barrel in different passages of the music, is thus avoided: —

The hammers are always kept raised, and are only allowed to drop by the agency of the musical barrel. The instant they fall they are lifted again, and, so long as the lifting is accomplished quickly enough, the time of lifting has nothing to do with the production of the air. That is determined solely by the musical barrel, which, being relieved of the work of lifting, has little or no strain on it, can be made small and light, and will always revolve at the same rate, and so insure that the tune shall be played in perfect time. It also follows that rapid passages can be played with great ease and precision.

The carillon of the Champ-de-Mars at the Paris Exposition of 1878 was the manufacture of M. Bollee, at Maus, and the statement was made in the presence of the author that the carillon of Buffalo was made by the same founder.

Carillons . . . . . "*Manuf. & Build.*," x 252.
French Exposition . . . * "*Sc. American Sup.*," 2093
Chimes, Centennial . . . . "*Iron Age*," xvii., June 29, p. 3
Chiming clock, Bombay Univ *"*Sc American Sup.*," 946.

See also BELL, CHIME, and list under MUSICAL INSTRUMENTS, "*Mech. Dict.*," page 1501, *et infra.*

Car Jour'nal Bear'ing Bor'ing Ma-chine'. See CAR-BOX BORING MACHINE.

Car Load. Nominally, a car load is 20,000 pounds. It is also —

70 barrels of salt.	17,000 feet of siding.
70 barrels of lime.	13,000 feet of flooring.
90 barrels of flour.	40,000 shingles.
60 barrels of whiskey.	340 bushels of wheat.
6 cords of soft wood.	200 sacks of flour.
18 to 20 head of cattle.	340 bushels of corn.
50 to 60 head of hogs.	680 bushels of oats.
80 to 100 head of sheep.	400 bushels of barley.
9,000 feet of boards	360 bushels of flaxseed.
(One half less of hard lumber, one fourth less of green lumber, one tenth less of joists, scantling, and all other large timber.)	360 bushels of apples.
	430 bushels of Irish potatoes.
	360 bushels of sweet potatoes.
	1,000 bushels of bran.

—"*Butter, Cheese, and Egg Reporter.*"

Car Ma-chin'e-ry. Machines and tools for metal and wood work on cars are assembled in lists on pages 1425, 1426, 2814, 2815, "*Mech. Dict.*" For machinery in general see list under MACHINES, infra.

Boring machine, horizontal. *"*R.R. Gaz.*," xxiii. 220;
Fay . . . . . * xxiv. 109.
Wheel borer, *Bement* . . . . *"*Engineering*," xxi. 505.
Putnam Machine Co. . . . *"*Sc. American*," xli. 210.
Bement . . . . . *"*Sc. American Sup.*," 518.
Box grinder . . . . . *"*Sc. American*," xxxv. 54.
Mortiser and borer, *Fay* . . *"*Railroad Gaz.*," xxiii. 67.
Truck drill, *Bement* . . . . *"*Engineering*," xxii. 69.
Wheel lathe, *Pfaff*, Saxony . *"*Engineering*," xxii. 174.
Double, *Fetu & Deliege*, Fr *"*Engineering*," xxviii. 148.
Collier, Br. . . . . *"*Engineering*," xxvii. 361.
Wheel tire lathe, *Collier*, Br. . *"*Engineer*," xlvii. 187.

Car Mor'tis-ing Ma-chine'. A class of large mortising machines, for working on sills and other parts of car frames

See Fig. 3237, p. 1482, "*Mech. Dict.*"

The bed of Fay's machine will receive timber up to 17″ square, and the chisel will cut a mortise to the center 16″ long and 8″ deep; or by changing the face of the stick it can be made to work clear through. It has two boring attachments, one on a line with the chisel to bore for the mortises, which will bore to 10″, from the center of column; also, an adjustable auxiliary boring attachment, for boring bolt holes, which will bore 17″ stuff.

See also CAR-SILL MACHINE.

Car'pet. A cloth or rug to cover a floor.

Loom, *Gates* . . . . . *"*Sc. Amer.*," xxxvii. 102.
*"*Sc. Amer. Sup.*," 1254.
Manufacture of, Philadelphia . "*Sc. Amer. Sup.*," 947.
Brussels, manufacture of . . "*Sc. Amer. Sup.*," 613.
Rag looper, *Wyckoff* . . . . *"*Sc. Amer.*," xxxiv. 118.
Sewing machine, *Hesse* (Singer) *"*Sc. Amer. Sup.*," 3802.
Smyrna and Persia, manuf. of . "*Sc. Amer.*," xxxix. 264.
Thread dressing Machine . . *Short* . . Patent, 139,521.
Carpet printing machine . . *Crossley* . . . 95,777.
Printed piled carpet . . . . *Crossley* . . . . 139,706.
Loom . . . . . *Murkland* . . . . 123,037.
Matching machine . . . . . 149,956.

History of the rise and development of carpet-weaving in America: *Hayes* in "*Centennial Report*," v. 70–75. See also page 475 *et seq.*, "*Mech. Dict.*"

Car'pet loom. The Dornan ingrain carpet weaving needle loom is arranged for 16 colored wefts, the vertical lifters being arranged in two ranks and the threads being passed through holes in them so that the thread appropriate to the pattern is lifted into the path of the carrier needle and carried into the middle of the shed where it is met by a hook which catches the weft thread and retires with it to the other selvage where it is knit in by a latch-needle.

The Jacquard mechanism determines the selection of the colored weft thread by raising the weft-lifter. The spools of yarn are placed on skewers on a frame upon the floor. A part of the pattern is given by the warps of solid color, being due to the concurrence of the same colors in the warp and weft. The warp is laid double in the shed.

A forked temple is combined with the jaw temple and a finger extending over the lay holds the several weft-threads in position. The lay operates the let-off and take-up, and the connection with the lay is controlled by a pivoted piece. The Jacquard has a counterpoise motion, having one top-board and two trap-boards. The journals are operated by hooked bars placed in and out of gear with the slides which support the trap-boards.

See, also, NEEDLE-LOOM.

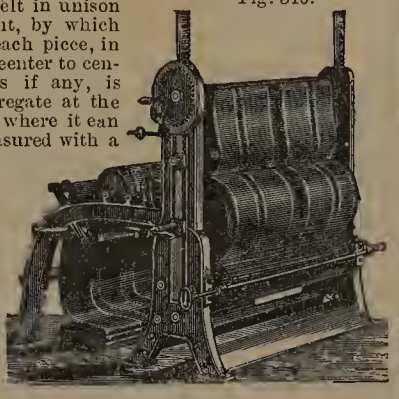
The Murkland power carpet loom is also for weaving ingrain carpets and operates by Jacquard and by shuttles. It carries 20 shuttles and weaves 16 colors. The shuttles are carried in boxes on each side and the selection of color is controlled by the Jacquard, which also governs the warp so as to float the required weft colors in accordance with the pattern. The loom is perfectly automatic.

Car'pet Match'ing and Meas'ur-ing Ma-chine'. Carpets which are woven in patterns for matching often vary in the distance from center to center of the figure from various causes, although the greatest care be taken to have them alike. The variations being sufficient to prevent some of them from matching properly, it is customary to measure each piece with a measure corresponding to the length of the figure, and note the difference, whether over or under the standard, on the tag, so that the pieces which agree in length of the figures may be put together.

Short's machine for matching and measuring carpets has an endless belt with divisions of its length corresponding

with the distance from center to center of the figure of the carpet to be matched: also mechanism in connection therewith for drawing the goods over a table alongside of the belt in unison with its movement, by which the variation of each piece, in the distance from center to center of the figures if any, is shown in the aggregate at the end of each piece, where it can be accurately measured with a rule, to be noted on the tag attached to the piece when rolled.

Fig. 546.

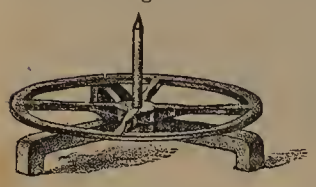


Carpet Winder.

Combined with the mechanism employed for drawing the goods along the matching device, and operating the latter, is mechanism for measuring, singeing, brushing, and rolling the goods at the same time they are matched, by which one movement of the goods answers for all these several operations.

Car'pet Wind'er. A machine on which carpet is smoothly wound in rolls from the pile or from the floor. In Fig. 546 the axis is horizontal, and in Fig. 557, the roll is vertical, being a wheel with a vertical spike revolving on a stand placed on the floor of the carpet room.

Fig. 547.



Carpet Winder.

Car Push'er. A lever for moving a car by making a fulcrum on the rail and lifting against the wheel.

See PINCH-BAR, Fig. 3725, p. 1706, "*Mech. Dict.*"
Blakeslee. * "*Scientific American*," xliii. 38.
Fessenden. U. S. Patent, December 31, 1878.

Car-re' Bat'te-ry. (*Electricity.*) A Daniel battery using parchment paper for the porous partition.

"*Niaudet*," American translation, 108.

Car Re-pla'cer. A device for replacing derailed cars.

Newcomb . . . . . * "*Railroad Gaz.*," viii. 191.
Northern Railway of Fr. . . * "*Engineering*," xxvii. 459.

Car'riage. Specifically: a four-wheeled vehicle for passengers and capable of being closed. See list of various vehicles on pages 2695, 2696, "*Mech. Dict.*," and parts of, appliances and tools for, *Ibid.*, page 2696.

Axle, *Hendry* . . . . * "*Iron Age*," xviii., Dec. 14, p. 1.
Building, history of the art, *Thrupp*, Engl. . . * "*Sc. Amer. Sup.*," 901, 920.
"*Sc. American Sup*," 1178.
Factory, *Brewster* . . . * "*Scientific Amer.*," xl. 79.
Springs . . . . . * "*Am. Manuf.*," Feb. 7, 1879, p. 13.
Dexter . . . . . * "*Iron Age*," xviii., Aug. 10, p. 1.

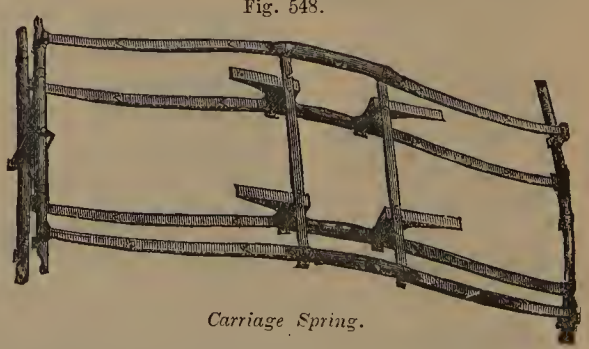
Car'riage and Wag'on Hard'ware. See under the following heads: —

Anti-rattler.
Anti-rattler fifth wheel.
Apron fastener.
Axle block.
Axle clip.
Axle lubricator.
Axle saddle.
Axle yoke.
Back-stay end.
Band.
Billet.
Body coop.
Bolster plate.
Bolt.
Bow iron.
Bow joint.
Carriage bolt.
Carriage spring lock.
Clip king-bolt.
Clip plate.
Clip yoke.
Coach clip.
Coach door handle.
Coach lock.
Corner iron.
Dash.
Dash foot.
Dash frame.
Dash lamp.
Door handle.
Drive knob.
Eye.
Eye ferrule.
Feed-box hasp.
Felloe holder.
Felloe plate.
Fifth wheel.
Foot rail.
Front stay end.
Full circle.
Gridiron step.
Hammer strap.
Hand plate.
Head-block plate.
Joint end.
Joint eye.
King bolt.
King bolt tie.
King bolt yoke.
Loop head.
Loop yoke.
Neck yoke socket.
Offset.
Perch loop.
Perch iron.
Perch plate.
Perch stay.
Platform-spring shackle.
Pole coupling.
Pole crab.
Pole eye.
Pole socket.
Pole tip.
Pole yoke.
Prop.
Prop-block washer.
Prop nut.
Reach.
Reach plate.
Reach socket.
Rockaway band.
Rub iron.
Saddle clip.
Safety loop.
Seat fastener.
Seat lock.
Shaft coupling.
Shaft eye.
Shaft loop.
Shaft rubber.
Shaft tip
Shifting carriage rail.
Shifting rail.
Side bar.
Side bar spring shackle.
Slat iron.
Sleigh shaft coupling.
Spring bar clip.
Spring block.
Spring buffer.
Spring clip.
Spring coupling.
Spring shackle.
Standard brace.
Stay-chain hook.
Stay-end.
Stay-end clip.
Stay-end tie.
Step.
Step pad.
Step shank.
Stump joint.
T brace.
Thimble skein.
Top brace.
Top joint.
Top prop.
Top prop nut.
Tufting button.
Wagon-box rod plate.
Wagon coupling.
Wear iron.
Whiffletree brace.
Whiffletree circle.
Whiffletree coupling.
Whiffletree hook.
Whiffletree plate.
Whiffletree tip.
Whiffletree tongue.
Whip socket.
Yoke.

Car'riage Cut'ting-off' Saw. A cross-cutting saw, mounted on a table which has a sliding carriage on which the work is placed to be presented to the saw. See CUTTING-OFF SAW.

Car'riage Spring. The spring shown in Fig. 548 consists essentially of two semi-elliptic side springs upon each side. The two springs are rigidly attached to each other at their centers, and are pivoted at their ends to spring-links above, or on either side of the axle or head-block. The spring shackles are rigidly attached to the head-block and rear axle respectively. The parallel motion of the springs prevents rocking of the axles. One spring being above the other, prevents side motion and the settling of the body to one side. The absence of a reach allows either wheel to pass over an obstruction almost independently of the other wheel. The elasticity of the springs takes much strain off the fifth wheel, and cushions the stroke when striking an obstruction.

Fig. 548.

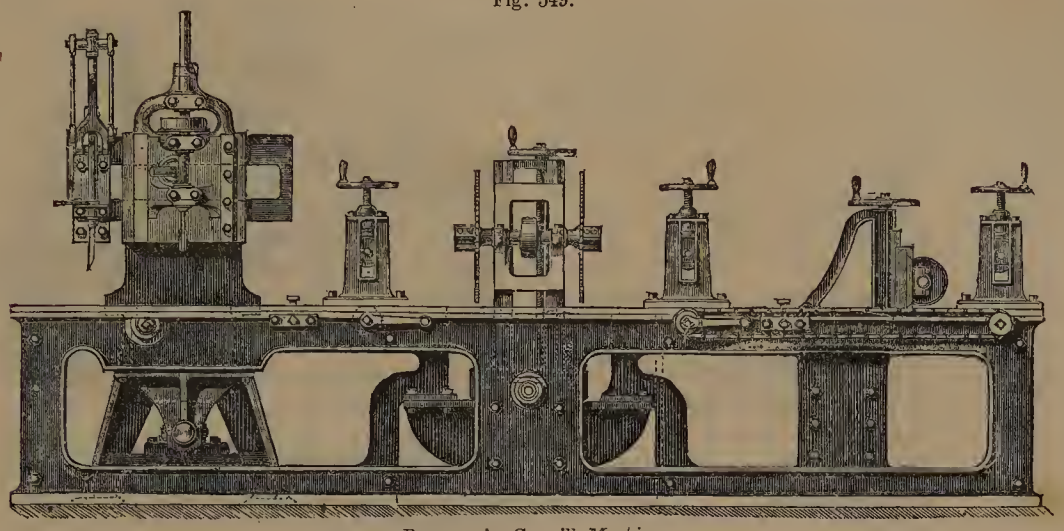


Carriage Spring.

See, also, BUGGY SPRING.

Car Seal. A disk of lead or pewter inclosing the ends of a piece of wire which has been rove in a hasp or ring in a car-door fastening. The disk is stamped so as to prevent the opening of the door

Fig. 549.



Ransome's Car-sill Machine.

without the cutting of the wire or defacing the device.

Car'-sill Dress'ing Ma-chine'. A traverse planer especially adapted for trueing and bringing out of wind the timbers for car-sills. These are planed to absolute shape by being dogged to stiff bed, and not merely dressed to thickness.

The Daniells or traverse planer is used, Fig. 3796, p. 1728, "*Mech. Dict.*"

Car'-sill Ma-chine'. A machine having arranged upon it all the various tools for preparing the sills or sole plates of railway cars. The bed has rollers on which the sills move longitudinally to present them to the various tools for mortising, boring, gaining, recessing, etc. See Fig. 549.

Car'-ten'on-ing Ma-chine'. A large sized tenoning machine, adapted for working on sills and parts of framing of cars.

Such a one is the *Gap-bed Tenoning Machine*, Fig. 6305, p. 2532, "*Mech. Dict.*"

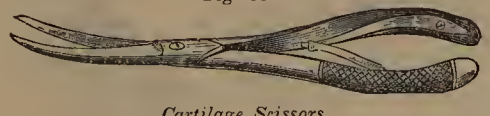
See, also, CAR-SILL MACHINE.

Car'ti-lage Knife. (*Surgical.*) A stout, scalpel-shaped knife for severing cartilage. Used in dismembering, post-mortem, dissection.

Figs. 146, 314, 350, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Car'ti-lage Scis-sors. A heavy pair of scissors for dividing cartilages.

Fig. 550.



Cartilage Scissors.

Car Trans'fer Truck. See CAR-TRUCK SHIFTER.

Car'tridge. (*Fire-arm.*) A loaded capsule or case. The case is made of paper or metal; the former, until of late years; now almost universally of metal, — copper or brass.

Cases are *cylindrical* or *bottle-nosed:* in the latter, the portion containing the powder is one or two bores larger than the actual bore of the piece, the chamber being reamed out for that purpose. By this means a shorter case may be used and the proper charge of powder retained.

In cartridge-making 18 different machines are used: 8 to form the case, 3 for the bullet, 5 to make the anvil or cap, and 2 for loading the cartridge.

The first process is called *cupping*, which is done with a die working inside a cutter. A sheet of copper 3″ wide is fed under the cutter by the attendant and a circular blank 1½″ in diameter is cut, and then pushed through a flaring-mouthed die by the punch, thus making it into a cup-shape about 1″ in diameter and ½″ deep.

In the next machine, called the *first draw*, the cup is fed over the die by the revolving plate and an automatic movement, which takes one at a time off the plate and places it over the die, which is somewhat smaller than the one in the cupping machine. It is then pushed through by the punch. It passes subsequently through four more *drawing machines*, each one making it longer and narrower, until it becomes 2″ long and ½″ in diameter. After the third *draw* it is annealed, having become hard by working.

After passing through the fifth draw it is put in the *trimming machine*, and the edge made even by a revolving cutter which reduces it to a certain size.

The capsule is next put into a machine called the *header*, which spreads the closed end into a head by pressing it into a mold.

The ninth process, *anvil-cupping*, is the same as the first, except that it produces a cup about ⅜″ diameter and ⅛″ deep for the cup to hold the fulminate. The anvil is then trimmed in another machine; in the next, called a *venting machine*, two small holes are punched in the head to afford passage for the fire of the fulminate to reach the charge. It next has an impression made in the outside of the head for the wafer of fulminate, and is next put in the *priming machine*, where it receives the fulminate. The practice with *central* fire and *rim*-fire cartridges diverges at this point; in the latter case the fulminate is secured by crimping the case from the outside, the same machine tapering the open end of the case to receive the bullet.

The bullets are made by a machine which cuts about 1″ from a rod of rolled lead ¼″ in diameter, and presses the leaden blank in a mold, which gives the shape and makes the three circumferential grooves. The next machine trims the bullets, which then pass through the *lubricator* which fills the grooves with Japanese wax, the object of which is to keep the barrel of the gun lubricated.

The last machine is the *cartridge loader*: the cases come successively under a powder reservoir where a charge of 72 grains is dropped into each, after which the bullet is put in, and the shell pressed around it to hold it firmly.

The following is a list of the machines included in the exhibit of the War Department at the Centennial Exhibition, 1876, under the orders of Lieutenant Metcalfe, in the Government Building; several machines are practically duplicated, as the successive drawing machines for instance: —

Cupping machine.	Priming machine.
Anvil cupper.	Loading machine.
Lubricator.	Drawing machine.
Case trimmer.	Clamp milling machine.
Impression machine.	Bullet machine.
Butt lathe.	Heading machine.
Barrel-boring machine.	Milling machine.
Barrel-turning lathe.	Rifling machine.
Straightening machine.	Bedding machine.
Tapering machine.	

See account in "*Scientific American Sup.*," * 369.

Norton's report on "*American Breech-loading Fire Arms*," N. Y., containing a description of the following cartridges: —

Boxer, British, central fire.
Daw, British, central fire.
Chassepot, French.

Zundnadelgewehr, German.
Meigs.
U. S. Cartridge Co.

See report on "Performance of Metallic Cartridges," at Frankfort Arsenal, Penn., by Major Treadwell, U. S. Army, 1873. Notices and illustrations are given of the following (* illustrated): —

Burnside	* 1860.
Maynard	* 1860.
Spencer	* 1864, rim primed.
Primitive	* 1864.
Laidley	* 1865.
Novelty	* 1866, center primed.
Bar-auvil	* 1866.
Gatling	* 1865.
Canister	*
Benton	* 1867, cup reinforce.
Tibbal	* 1869.
Benet	* 1868, cup anvil.
Service	* 1868, blank cartridge.
Benet	* 1866, center-primed.
Crispin	* 1867, combiuation: paper and metal.
Colt	* 1868.
Martin	* 1869.
Corliss	* Front ignition.
Prince	* Front iguition.
Milbank	* 1870, reloading.
Milbank, et al.	* Primer.
Reinforced	*
Frankford	* Gas check.
	* Attached head.
Rodman-Crispin	* 1863, wrapped metal.
Boxer-Henry	* 1872, wrapped metal.
Frankford	* 1872, cast base.
Hotchkiss	* 1868, solid head.
Benet	* 1868, solid head.
U. S. Cartridge Co.	* 1868, solid head.
Dutch musket	* Reloading shells.
Dutch carbine	* Reloading shells.
Farrington	* Solid head.
Navy	* Front lubrication.
Frankford	* 1865.

See report of Major Bell to Colonel Craig, Chief of Ordnance, May 16, 1856, on the firing of Dr. Maynard's breech-loading rifle charged with a metallic cylindrical water-proof cartridge.

Cartridge, *Tyler*	* "*Scientific American*," xli. 246.
Making	* "*Sc. American Sup.*," 2670.
Center fire, *Saget*	* "*Scientific American*," xliii. 36.
Cartridge shot, *Schleber*	* "*Scientific American*," xl. 212.

The Russian small arm cartridge factory near St. Petersburg is described in "*Ordnance Report*," 1877, pp. 519 *et seq.*

Car'tridge Block. A wooden block, bored to receive 8 cartridges, and having attachments by which it is secured to the gun in convenient position for loading. It is shown in Fig. 552 as attached to a *Peabody-Martini* military rifle.

Car'tridge Cap'per. An instrument for securing caps on central fire cartridge-cases. The pivoted lever has a stud beneath, which presses the cap firmly upon its seat. Fig. 551.

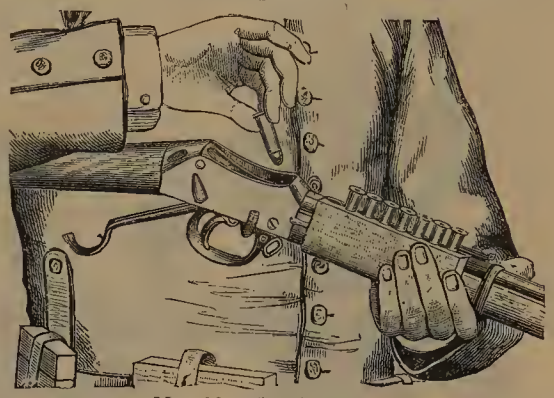
Fig. 551.

Parker Bro.'s Cartridge Capper.

Car'tridge-head'ing Ma-chine'. A machine for forming the head or rim of a cartridge case. It consists of a horizontal die, countersunk at one end for shaping the head; a feed punch, to insert the tubes into the die; and a heading punch, to flatten the closed ends of the tubes into the countersink.

The tubes, which are a little longer than the completed cases, are fed into the inclined trough of the machine, whence they are taken up on the feed-punch. A shoulder on this punch, at a distance from its extremity equal to the inner depth of the headed case, prevents it from penetrating to the full depth of the tube, and a surplus of metal is thereby left at the closed end of the tube for the formation of the head.

Fig. 552.



Metcalfe's Cartridge Block.

The feed-punch inserts the tube into the die and holds it while the heading punch advances, presses and folds the surplus end of the tube against the countersink die, thus shaping the head or rim. The headed case is left in the die as the feed-punch retreats, and is expelled by the next case.

The rate is 65 per minute.

Car'tridge-head Test'er. A hydrostatic press invented by Col. Treadwell, U. S. Army, for testing strength of cartridge heads.

Plate XXIII., Ordnance Report, U. S. Army, "*Metallic Cartridges*," 1873.

Plate XXIV. *et seq.* of the same, show the powder test by eprouvette.

Car'tridge Load'ing Ma-chine'. 1. A machine for loading powder and bullet into a cartridge case.

It consists of a revolving circular plate with holes, and a hopper and powder measure.

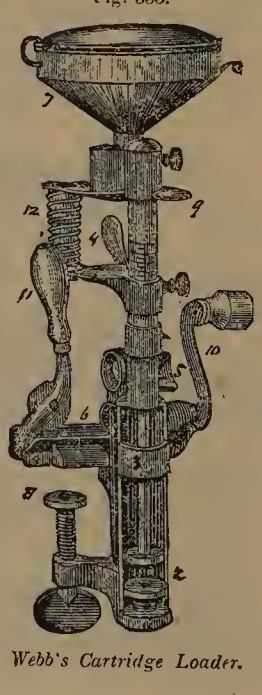
The powder is placed in a brass hopper above the machine, and is fed to the cases through a paper tube; the whole inside of a conical shield of boiler iron.

The cases and bullets are fed on revolving plates: the former lifted into the receivers, passed under the hopper and measure for a charge of powder, and then under the bullet-feeder to receive a lubricated bullet. The edge of the case is crimped on the bullet by lifting the former into a contracted space of the receiver around the neck of the bullet.

A bell indicates any failure in the supply of a full charge of powder, and the rate is 35 per minute.

2. On a smaller scale, a machine for reloading cartridge shells.

Fig. 553.



Webb's Cartridge Loader.

The machine is clamped to a table, leaving the crimper crank 10 free to turn. The reservoir 7 being furnished with powder, the charger 9 is set to the number of drams required. Hold the shell under the aperture of 12 in the lower shelf of charger, and dump the powder therein. Having loaded the shells with powder, remove the funnel and release the rammer; put the shell in the receiver 2, place the wad on the powder and ram home. Fill the reservoir with shot, set the charger at the gage desired, drop the charge, place a wad on the shot and ram as before; or crimp the shell, placing it in the cradle 6, and rotating the revolving hub by the crank 10. The shell may be shortened before crimping by placing it on 5 and rotating it while the knife 4 is pressed upon it.

Car'tridge Scales. A machine for automatically verifying the weight of cartridges; invented by *Gootkoffsky*, of the ordnance works, St. Petersburg, Russia.

"The scales are composed of eight balances, slung to the tyre of a small fly-wheel which is brought into action by the main shafting. The cartridges placed by the workmen in the box are caught up by the scales themselves and are placed in the balances. The cartridges are equipoised by a reacting weight placed on the opposite ends of the balances; on the farther rotation of the fly-wheel, the balance gradually comes to an equilibrium, upon which the cartridges of a normal weight, and heavier than the normal weight are declined along with the outer end of balance downward, and are thus pushed off by the scales themselves into the receiver, from whence they fall into a box placed on the floor. The cartridges which are of less than the normal weight, are raised upward and are thrown off by the scales themselves into another receiver, from whence they fall into a locked-up box. The fly-wheel with the balances makes 7½ revolutions per minute, that is, performs 3,600 weighings per hour, or 30,000 per day, allowing for subsidiary work and chance stoppages."

Car'tridge Var'nish-ing Ma-chine'. A machine to coat the interior of metallic rifle shells with an impermeable elastic varnish, to prevent chemical action between the salts of the gunpowder and the material of the shells.

The shells are placed in a hopper, several hundreds at a time, and fed singly into a wheel, with which they revolve, while they are also rotated in the chucks which hold them; this in order to spread the varnish. Forty of them are in different stages of the process at the same time, and the work is done at the rate of 2,000 per hour. The machine is perfectly automatic. The shells are subsequently dried in a sheet-iron furnace.

Cart Rol'ler. A roller which has a cart body mounted upon it. Used in some parts of France for transporting manure on soft prairie ground.

Car Truck. The wheeled frame beneath the body of a railway car.

Iron, *Challender* . . . * "*Railroad Gazette*," xxi. 198.
English . . . . . * "*Sc. American*," xxxviii. 226.
Passenger, *Ramapo Co.* * "*Railroad Gazette*," xxi. 257.
42-inch, *Ramapo Co.* . * "*Scientific American Sup.*," 1298.
Pennsylvania Railway . * "*Engineering*," xxiv. 366, 375-378.
Safety device, *Root* . . * "*Scientific American Sup.*," 142.

The principal forms are shown in *Forney's* "*Car-builder's Dictionary*."

Car'-truck Frame Drill'ing Ma-chine'. A multiple drill machine, for drilling at one operation the different holes required in car truck frames.

The frame to be drilled is laid upon the table, which is then fed up to the drills, either automatically or by hand through the gearing. The drills are mounted on an upper frame, at the standard distance apart, and are driven by gearing from the coned pulleys. The drill spindles slide in the vertical holders, which are tubular, and they can be locked in any desired position by set screws at the ends of the holders. The drill spindles can be adjusted on the cross frame to different distances apart so as to suit different patterns of car frames.

Car'-truck Shift'er. An invention, for changing the trucks of cars on roads having different gages, as well as for changing trucks when repairs or new trucks become necessary.

AA represent level outside tracks along the depressed main tracks; *EE* represent trucks on the outside tracks, and *F* the cross-bars or beams for carrying the car body.

To separate trucks from a car body, the car is run to the incline of the pit B, and the small truck *E* placed on each side. The supporting beams or cross-bars *F* are then placed under the frame of the car between the bolsters, the ends of the cross-bars resting on the side trucks at opposite sides of the car. Then, by moving the car over the pit *B*, the car-trucks *D* run down the incline rails, leaving the car body supported by the side trucks *E* and supporting beams *F*. To connect trucks, after the above described process is accomplished, they are run up the incline until the bolt-hole of the truck connects with the king-bolt of the car, and then, by moving the car forward, the king-bolt draws the trucks up to their proper place.

"*American Railroad Journal*" . . . xlix. 1080.
* "*Polytechnic Review*" . . . . . Sept. 9, 1876.
* "*Iron Age*," . . . . . xviii., Sept. 7, p. 1.
* "*Railroad Gazette*" . . . . . xxiv. 267.
* "*Scientific American Supplement*" . . 705.

Car Un-load'ing Plow. Dowling's plow for unloading platform gravel-cars, is a V-shaped implement which has two flaring wings. The cars being made stationary, the locomotive is detached, and, being connected to the plow draws it the whole length of the train from car to car, depositing on each side of the track the gravel with which the cars are loaded. See also Patents 63,139, 91,440; grain-scoops for unloading.

"*Railroad Gazette*" . . . . . * xxiii. 249.

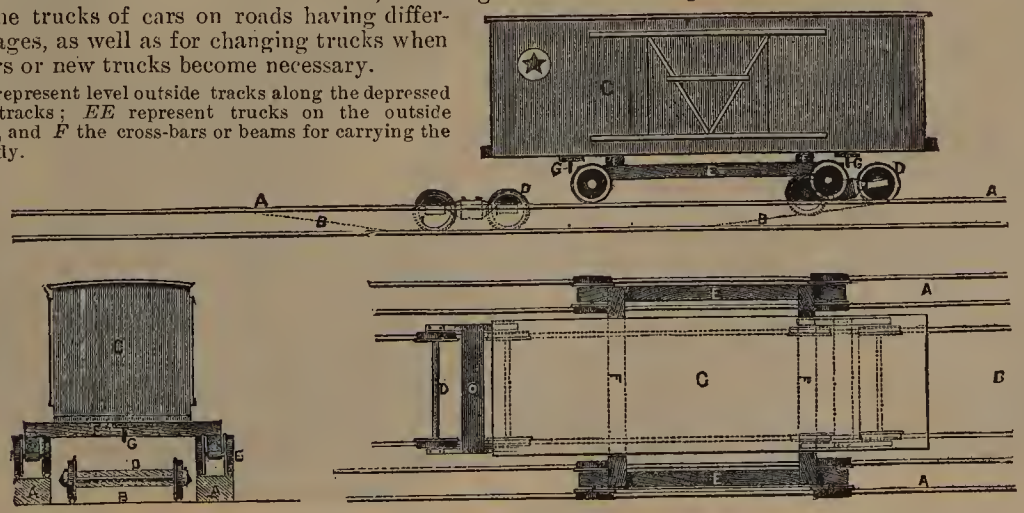
Car Ven'ti-la'tor. A device for renewing the air of a railway-car. See CAR VENTILATOR, * pp. 490, 491, "*Mech. Dict.*," and AIR FILTER, * pp. 46, 47, *Ibid.*

Winchell's Car Ventilator consists of an air-chamber attached to the roof of the car and extending its entire length. Each end is furnished with a hood, protected by very fine wire gauze screens, through which air alone is admitted to the chamber. Each drum is furnished with a cut-off, operated by a lever within the car, by means of which the supply of air may be regulated. A number of registers in the bottom of the chamber admit the air to the car. When the train is in motion the cut-off in the forward end of the car is opened, and the air enters, passes down through the registers, enters into the car, and, having served its purpose, makes its exit through the rear hood or through the windows, if they are open. In connection with the air-chamber, and for summer use only, are deflectors on the outside of each window, whose purpose is to act as an exhaust, and not only draw out the impure air from the car, but prevent the admission of smoke, dust, cinders, and rain through the open window. These deflectors, which are made of glass, so as not to impede the view from the windows, are operated simultaneously by an iron rod running along the side of the car.

Winchell . . . . "*Van Nostrand's Magazine*," xiv. 187.
"*American Railroad Journal*," xlix. 318.
"*Scientific American*," xxxvii. 262.

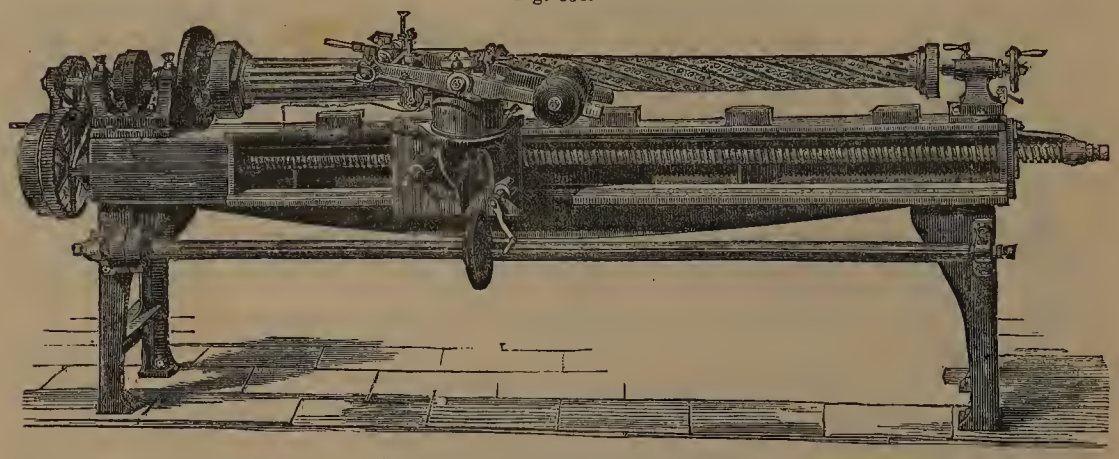
Carv'ing. The ancient, mediæval, and modern, the Orient and the Occident, vie in wood carving.

Fig. 554.



Ramsey's Car-truck Shifter.

Fig. 555.



Arbey's Carving Attachment for Lathes.

It may be said that the art has a renaissance, and the exhibitions show in great numbers imitations of the antique, the grotesque and ornate works of the laborious Orient, and the labors of the graceful modern school.

The Japanese carvings in ivory are familiar, and it may almost be said are beyond praise.

The Chinese carvings in wood are usually in teak, box, and rosewood. Much of the carving in light wood comes from Ningpo; the dark from Canton. Gilding and painting of conventional designs in bright colors are more common than in the Japanese.

The carving of India is all hand work. Sandalwood carving is carried on largely in the Bombay Residency, at Surat, Bombay, Ahmedabad, and Canara. The two former are low relief and foliated ornament. The Ahmedabad is in flat relief, floral and mythological. The Canara, high relief and mythological.

Ebony is carved at Bijnur and Monghyr in geometrical designs.

Ivory is carved all over India: gondolas, elephants, cows, peacocks, statuettes, mythological figures, etc., at Amritsar in the Punjab; Benares, Behramporc, and Murshedabad in Bengal; Travancore and Vizianagram in Madras.

The agate vases of Boroach and Cambay have been celebrated as *murrhine* vases from the time of Pliny.

Black marble is carved at Gya, white marble and reddish sandstone at Ajmere and other parts of Rajpootna. The latter province is celebrated for its white marble idols colored in red, green, and gold. Jade is carved in Cashmere.

The most conspicuous work in Paris, in the Champ de Mars, was the Italian. Usually in low relief, the designs were copies from plants and natural objects, and the beauty of the execution left little to be desired.

Plate VII. shows four panels carved in walnut by Prof. Luigi Frullini, of Florence, and purchased for the Museum of Buda-Pesth.

In regard to the choice of wood for carving, it is said that the magnificent carvings of Grinling Gibbons, at Chatsworth, Petworth, Burghley, Gatton, and other mansions in England are almost exclusively in lime-tree wood (*tilia*). The wood is soft and pliable, and is little liable to split and splinter. It takes a stain well, and, when merely varnished, resembles box.

American walnut is more open in its grain than lime, and more fragile. The color is a great point in its favor — at present.

Sycamore is used for large and coarse work, — bread-plates and bowls, for instance. Chestnut is used also. Holly is a very superior light-colored, even-grained wood.

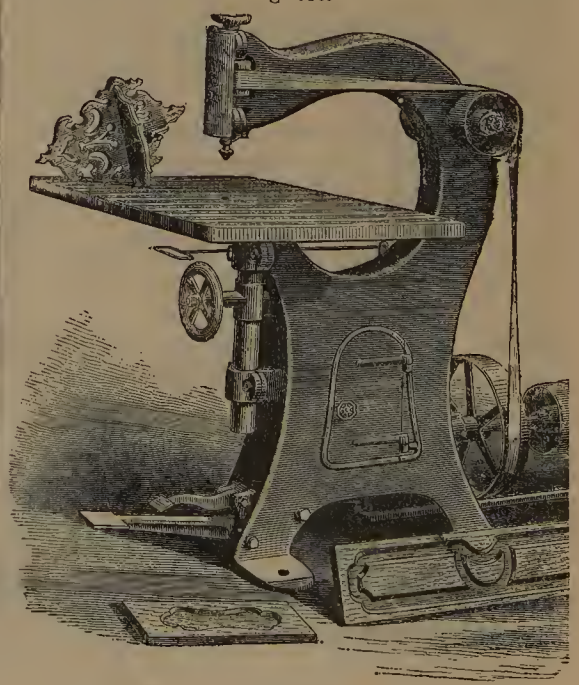
Oak is admirable for certain classes of work, and there is more carving extant in oak than in any other one wood. The European walnut is much harder and more enduring than the American, and much harder to work.

Boxwood is the best of all white woods, but is small in size and hard almost as bone. Its use is confined to delicate work. Ebony is the best of black woods. Pear and apple are excellent in their way, being hard, rigid, and tough. Ironwood and dogwood are favorite woods for turners and carvers, approximating boxwood in quality.

Carv'ing Lathe. A lathe, Fig. 555, with an attachment which qualifies it for grooving, channeling, and ornamenting columns, balusters, table and piano-legs, and similar articles of irregular shape.

The carving attachment is placed on a traveling-carriage, and supported on an adjustable cylindrical standard, to which the balanced arms of the cutter shaft are pivoted, the latter being revolved by a pulley and belt connection with a traveling pulley of the cutter-actuating shaft. The cutter shaft is movable on its bearings by a lever handle, while the pulley is retained by a clutch connection with a fixed brace of the weighted arms, and it is raised or lowered by means of a curved arm and guide-roller passing along the pattern of the form. When a table-leg or other object is held in position of rest in the lathe, the cutting tool passes longitudinally along the same, and works out in it a groove or channel. The dividing disk being turned for the distance of one sub-division after each channel is completed, the next

Fig. 556.



Carving and Paneling Machine.

PANELS CARVED IN WALNUT BY PROF. LUIGI FRULLINI, OF FLORENCE

SHOWN IN PARIS IN 1878, NOW IN THE MUSEUM OF BUDA-PESTH.

PLATE VII.

See page 174.

channel is then produced by the return motion of the carriage. By turning the object slowly in the lathe, simultaneously with the revolving and traversing motion of the cutter, helicoidal channels or grooves are formed. For grooving conical parts, the cutter shaft is guided along an inclined guide pattern, or its axis is placed at an angle to the longitudinal axis of the lathe. The cutter adjusts itself to the shape of the object, and carves, by its uniform forward motion, an ornamental groove of equal depth throughout the entire length. For the purpose of pearling or doing other ornamental carving, the cutting tool is guided to the work by a handle, while the object is turned in the regular manner by the dividing disk, so that the pearls may be formed at uniform distances.

The adjustability of the cylindrical standard, in connection with the balanced cutter shaft and handles, admits of the convenient and accurate handling of the carving attachment, so that a large variety of ornamental work may be accomplished on this machine quickly and economically.

Fig. 557

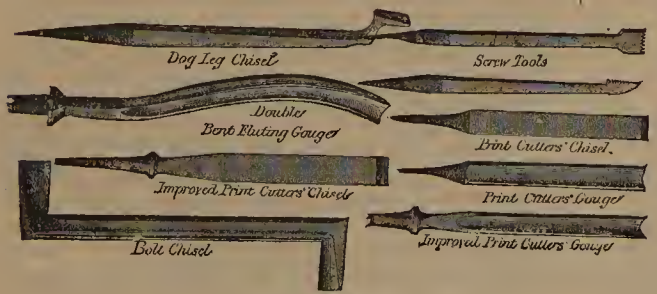
Carving Tools.

Carv'ing Ma-chine'. A machine for producing carvings and recessed or relieved panels on the surface of work; for making edge-molding, ornamental, fret, or bracket work, etc. Fig. 556.

A hollow iron column supports the cutter spindle and the table, which latter is adjusted and regulated to form the required depth of moldings or carvings by means of a hand-wheel and screw, and has sufficient vertical movement to admit of working stuff of 4″ thick and under. The table is elevated by a notched treadle to bring the material in contact with the cutter, and the piece, after being carved, is removed by an auxiliary treadle which disengages a pawl and allows the table to drop to its original position. The cutter may be driven in either direction.

And molding, *Boult* . . * "*Engineer*," xli. 430.
* "*Scientific American Sup.*," 580.
And paneling, *Fay* . . * "*Scientific American*," xxxiv. 390.

Fig. 558.



Carving Tools.

Pantograph principle.
Blackman . . . * "*Scientific American*," Aug. 14, 1875.
Arbey, Fr. . . . . * "*Scientific American*," xli. 243.

Carv'ing Tools. Figs. 557, 558 show a number of carving tools, each with its name subscribed. Selected from a still greater number, these yet show considerable variety.

Car'-wash'ing Ma-chine'. An invention of Lord Caithness for washing the sides of carriages.

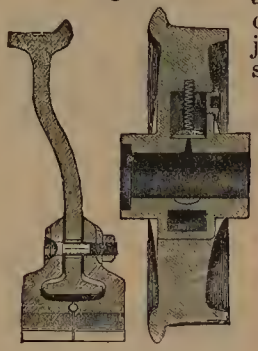
It consists essentially of two large vertical brushes driven by a steam engine. A number of dirty carriages, making up a train of any length, is passed slowly between these revolving brushes; water is thrown upon the side of each railway carriage, 2′ in advance of the brush, from a vertical iron pipe pierced with small holes, placed at an average distance of 8″ from each other. A second water pipe, pierced with similar holes, directs another series of small jets of water directly upon the brushes. The whole arrangement is not very dissimilar in principle to that of hair brushing by machinery.

Car Wheel. Car wheels, cast, wrought, compound, and compressed are shown on pp. 493, 494, "*Mech. Dict.*"

Fig. 559 shows two forms of car wheels, the Raddin and the Bryant.

The former, on the left, is an elastic wheel. Being cast in three parts, rubber cushions are interposed between the web and the hub, so that iron does not touch iron, and jars and concussions are absorbed by the rubber.

Fig. 559.



Raddin's Elastic Car Wheel.
Bryant's Self-lubricating Car Wheel.

Fig. 560.

Lobdell's Car Wheels.

The Bryant wheel, on the right, runs on, not with, the axle, and has a large chamber for oil which oozes through a sponge to the axle.

Fig. 560 shows two of Lobdell's wheels: the hollow-spoke wheel, and the combination double-plate wheel.

The Atwood railway car-wheel is another elastic in which hempen packing is interposed between the rim and the tire.

Hemp is packed into the chamber *K*, between the rim *D* and the tire *A*. The latter is held to the wheel by a lock

Fig. 561.

Atwood Railway Car Wheel.

joint *F G*, and a dovetail ring *M N*. *C C* are the spokes. *H* bolts to secure plate. *F* grooves in rim.

"*Herr Krupp* has lately patented an ingenious mode of manufacturing car wheels. A skelp is first formed of a long flat plate of iron, with a central rib above and corresponding groove beneath, and wide at each end. One end is secured to a rotating mandrel and is coiled on itself, forming the hub; the coiling being continued, the narrow portion of the skelp is wound on itself, forming the web; the coiling of the outer wider end forms the rim. The blank thus formed is placed in the furnace, heated to a welding heat, and welded under pressure into a homogeneous mass of the proper shape, forming the completed wheel. Apart from the facility of manufacture, the invention results in the production of an article of very superior merit, as the fibres of the iron are all arranged parallel to the periphery instead of being tangential or radial, as in wheels constructed by processes hitherto pursued."—"*Railway Review*," xiii. 172.

The endurance of some cast-iron car wheels is very great. Some of the Salisbury wheels of Barnum, Richardson & Co., have made the following record on the Lake Shore and Michigan Southern Railroad:—

4 wheels averaged	185,049 miles.
2 wheels averaged	220,528 miles.
2 wheels averaged	196,967 miles.
3 wheels averaged	189,397 miles.

Lobdell showed at the Centennial wheels which had been 25 years in service on the New York & Erie Railway.

Austrian car wheels by Ganz & Co., Buda-Pesth, made on the American style, were shown in Paris, 1878, one having run 329,400 miles, and another 380,000 miles.

"The paper car-wheels of the Pullman Palace Car Co., are calculated to run 450,000 miles."—"*Chicago Railway Review*."

See Report on "Chilled Cast-wheels for Railways," by *F. Slataper*, "*Centennial Exhibition Reports*," vol. vi., Group XVIII., p. 38 *et seq.*, giving the early history, from Losh & Steveuson, 1826, Bouuey, 1829, Elgur, 1833, etc., including—

Truscott, Wolf, and Dougherty, * 1838.
Bonney, Bush & Lobdell, * 1838.
Bush & Lobdell (double plate.) *
G. W. Eddy, * 1845.
Whitney.
Washburn, * 1850.
Lobdell (single plate). *
Lobdell (combination). *

Forney's "*Car-builder's Dictionary*," gives the following list with descriptions. See Figs. 181–184:—

Broad-tread.
Combination Plate.
Combination.
Compromise.
Double-plate.
Elastic.
Hand-car.
Hollow-spoke.
Narrow-tread.
Open-plate.
Pair of Wheels.
Paper.
Plate.
Sax and Kear.
Single-plate.
Spoke.
Steeled.
Steel-tired.
Steel.
Street-car.
Washburn.
Wrought-iron.

The parts of a car-wheel are, according to its construction:

Flange.	Plate.
Tread.	Ribs.
Rim.	Spokes.
Face of Rim.	Center.
Tire.	Hub.
Retaining Rings.	Axle-seat.

See also PAPER CAR-WHEEL.

Paper, *Allen*	"*Iron Age*," xxi., Jan. 31, p. 18.
Tire-fastening, *Atherton*, Br.	* "*Engineer*," xlv. 198.
Steel tired, *Atwood*	* "*Railroad Gaz.*," xxi. 445.
Atwood, *Hamilton*	* "*Engineer*," xli. 463.
Baltimore Car Wheel Co.	* "*Railroad Gaz.*," xxi. 464.
Barnum, Richardson & Co.	* "*Railroad Gaz.*," xxi. 516.
Cast and wrought	* "*Railroad Gaz.*," xxi. 307.
Composite, *Cleminson*, Br.	* "*Engineer*," xlviii. 427.
Wood-centered, *Cleminson*, Br.	"*Iron Age*," xxv., Jan. 1, p. 1.
Large *vs.* small	* "*Railroad Gaz.*," xxi. 96.
For collieries, *Hadfield*	* "*Sc. Amer. Sup.*," 1565.
Disk, *Handyside*, Br.	* "*Engineering*," xxii. 392.
	* "*Engineer*," xlii. 309.
Mold	* "*Iron Age*," xxiii., May 15, p. 1.
Securing to axles, *Jessop & Sons*	* "*Sc. American*," xliii. 70.
Tire fastening, *Kaselowsky*, Ger.	* "*Engineering*," xxx. 80.
Wooden disk, *Kitson*, Br.	* "*Engineering*," xxii. 271.
Turned chilled, *Lobdell*	"*Sc. American Sup.*," 227.
	* "*Railroad Gaz.*," xx. 229.
Paige	* "*Sc. American Sup.*," 2.
Paper	"*Iron Age*," xviii., Sept. 21, p. 9.
	* "*Railroad Gaz.*," xx. 317.
Balancing, *Paris, Lyons & Medit. R. R.*	* "*Sc. Amer. Sup.*," 2794.
Foundry, Penn. Railway	* "*Engineering*," xxiii. 358
	* "*Engineering*," xxiv. 104.
Tires, fracture of. Paper on	"*Sc. American Sup.*," 917.
Self oiling, *Phillips*	* "*Sc. American*," xxxix. 8.
Steel-tired	* "*R. R. Gaz.*," xx. 553–554.
Large *vs.* small, *Wallis*	* "*Sc. Amer. Sup.*," 1057.
Swedish wrought iron	* "*Railroad Gaz.*," xx. 280.

Car Wheel Bo'rer. A machine tool for boring true the axle holes in car-wheels. It is a form of boring machine of special adaptation. The wheel is chucked centrally and horizontally on the bed and the boring tool brought upon it axially.

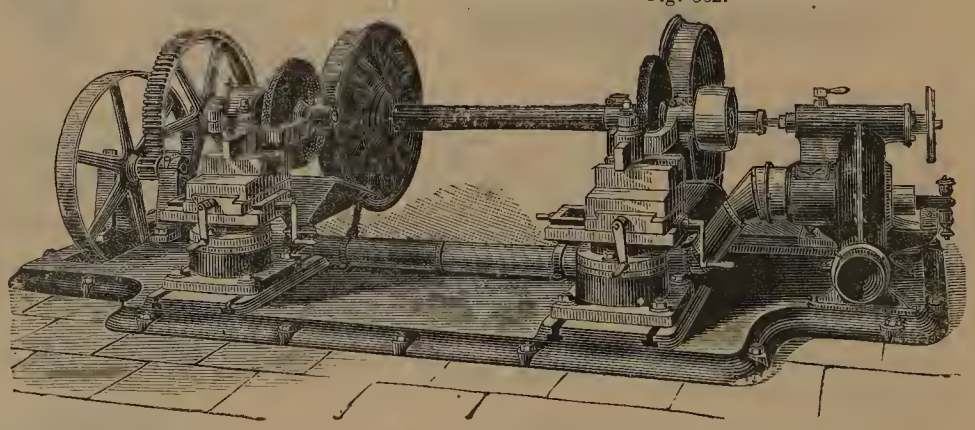
The car wheel lathe, Fig. 1172, "*Mech. Dict.*," is adapted for similar work, while it is capable of other duties also.

Car Wheel Chuck. A chuck adapted for holding a car wheel centrally upon a face plate for boring or tracing the rim. *Horton.* It is a form of universal chuck in which the jaws are simultaneously and equally approached by a single movement, so as to maintain exactly equal radial distance from the center of the chuck.

Car Wheel Grind'ing Ma-chine'. A machine for trueing worn car wheels by dressing the rim and flange.

In Gowan's machine, shown in Fig. 562, the pair

Fig. 562.



Gowan's Car Wheel Grinding Machine.

of wheels is chucked in a lathe, and two emery-wheels, mounted on tool rests, are applied to them. The object is to dress them to absolute roundness and normal shape of tread and flange, eliminating all flat places and every irregularity. The chilled car wheels revolve the reverse way to the ordinary lathe, at a rate of 1½ revolutions per minute. The abrading wheels are of No. 16 corundum, strong and porous, running at 600 revolutions per minute, 18″ wheel. A pair of 18″ × 1½″ wheels will true up 200 pairs of new 33″ chilled wheels, provided they are truly fitted to the axle. An exhaust fan withdraws the dust from both wheels.

"*Railroad Gazette*"	* xxiv. 625.

Case. *Add.* (*Mining.*) *b.* A vein of quartz, not containing ore, and forming an angle with the lode.

8. (*Founding.*) The cope.

9. (*Fire-arms.*) The capsule of a cartridge.

Case'mate. A vault with an embrasure.

The *Gruson* chilled iron casemate (German) is shown in Plates XXVI.–XXX., Barnard & Wright's report on "*Fabrication of Iron for Defensive Purposes*," U. S. Engineer Department, Washington, 1871.

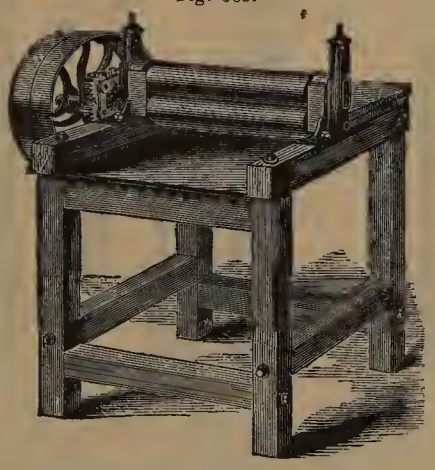
Casemate carriage for British 10-ton and 25-ton guns. Same report, p. 99, and Plate XVIII.

Casemates. Addendum to Supplement 21 of same report.

Case Trim'mer. (*Cartridges.*) An implement or machine, one or the other, used for trimming the mouths of shells for cartridges. These are fed by a funnel to the tool, which has a knife to cut them to an adjusted length.

Case Smooth'ing Ma-chine'. (*Bookbinding.*) A machine for smoothing cloth cases for books; an efficient substitute for the bone folder. The cases are passed between the rubber rollers, two at a time, insides face to face. The top roller is adjustable by means of set screws, to suit any thickness of cover.

Fig. 563.



Sanborn's Case Smoothing Machine.

Cash'mere. (*Fabric.*) 1. A fine-wool French dress goods, woven with a twill on one side and piece-dyed.

Merino has both sides twilled.

2. A mixed fabric with cotton warp and XX. merino wool weft, made in imitation of the Cashmeres d'Ecosse, which are all wool.

This goods is called Coburg in England.

Cashmere shawls. Hayes in "*Centennial Reports*," v. 75, 76.

Cash Re-cord'ing Ma-chine'. A machine on which is made and kept a tally of sums received or recorded.

A given sum being received by a salesman, for instance, he touches the knobs corresponding to (say) $, 1, 2, ., 4, 7, and the record $12.47 appears at a slot, and is at the same time printed on a slip (along with the date and name of the firm) which serves as a receipt, and on a second strip the series of sums which constitute a record of the day's receipts.

"*Scientific American*" . . . . . * xxxviii. 95.

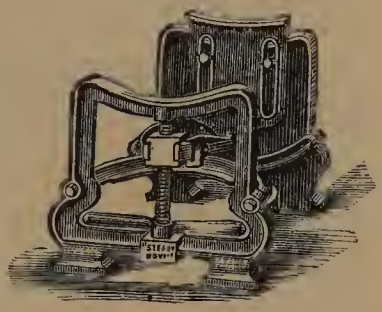
Cas'ing. (*Add.*) 4. (*Glass.*) Enclosing a blown object in another blown piece of similar shape and different color, and then blowing the inner one so that it expands against its envelope, when they may be firmly united by firing, and then finished as one piece.

5. (*Mining.*) A plank partition.

Cask. See BARREL.

Cask Stand. A support or stillion for casks, having an adjustable back support to tilt the cask when necessary. The lift is by a square chased screw, in order to give a steady movement to avoid disturbing the liquor.

Fig. 564.



Cask Stand.

Cas'se-role. A small pan, like a French stew-pan, used in laboratories.

Cas-so-lette'. A pan or tray for perfumes.

Cas'ter. A rolling foot.

Martin . . . . . * "*Iron Age*," xxii., August 8, p. 1.
Glass ball, *Adgate* . . * "*Scientific Amer.*," xxxviii. 374.
Ball, *Konz* . . . . . * "*Scientific Amer.*," xxxviii. 6.
Anti-friction rollers.
Gardner . . . . . * U. S. Patent, 111,193.

Cas'ter Rol'ling-col'ter. A wheel colter mounted on a swivel, so as to present in any direction the plow may be guided. Fig. 1391, p. 596, "*Mech. Dict.*" See COLTER.

Cast Gate. (*Founding.*) The channel through which metal flows into a mold. *Ingate.*

Cast'ing. References to devices may be found as follows: —

Preventing honeycombs in . . . . "*Sc. Am. Sup.*," 1842.
Small objects, *Hopkins* . . . . * "*Sc. Amer. Sup.*," 272.
Steel, *Wright, Smith & Butler*, Engl. "*Sc. Amer. Sup.*," 904.
Case hardening . . . . . "*Sc. Am. Sup.*," i. 353.

Cast'ing Net. (*Fishing.*) A net in extensive use in the West Indies, Florida, and elsewhere on the southern coast.

It consists of a circle of netting, varying in diameter from 4′ to 15′ or more, to the circumference of which are attached, at short intervals, leaden weights. There is a ferrule of bone or metal at a central opening in the net. One end of a long rope passes through this ferrule, and to it are attached numerous cords extending to the lead rope. The net is used by gathering up the casting-rope in a coil on one arm, and taking the net itself on the other. By a dexterous fling of the arm containing the net, this is thrown in such a way as to spread out completely, and it is hurled so as to fall perfectly flat on the surface of the water. The leads sink immediately, forming a circular inclosure, and imprisoning any fish that may happen to be under it at the time. The rope is then hauled in from the other end, causing the entire circumference to pucker inwardly, and the leads and puckered portion come together in a compact mass, in which the fish are entangled.

Cast Por'ce-lain. 1. A milk-white, somewhat translucent glass made from pure cryolite.

2. A uniformly colored or marbled variety of opaque glass made from impure cryolite.

The mixture for the milky variety is: 1 part of oxide of zinc, 4 parts of cryolite, and 10 parts of sand ore, fused in a common pipe-clay crucible, developing a large amount of fluosilicic acid. The pipe-clay is, however, not attacked much by it. This development continues throughout the fusion, and even after it, during the working to a small extent. This glass possesses a considerable hardness and power of resistance; even as a powder it is not attacked by strong acids. According to an analysis of Mr. Hagemann the composition is as follows: —

	Per cent.
Oxide of zinc	6.50
Silicic acid	63.40
Alumina	3.67
Soda	5.85
Oxide of iron and manganese	4.40
Undecomposed cryolite	15.14

The properties of this glass probably depend upon the presence of the undecomposed cryolite; for glass of the above composition, without any combinations of fluorine, is transparent and non colored. Glass with a small amount of cryolite has a milky-white, translucent color, and great brilliancy, refractive power, and strength. With a higher proportion it becomes opalescent, and with more cryolite, opaque and like porcelain.

Cat'a-lan Forge. (*Metallurgy.*) See Fig. 1185, p. 502, "*Mech. Dict.*," and BLOMARY, *supra.*

See also *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., article "*Forges Catalanes*," Fig. 1035.

"Catalan forges for smelting iron ore and blomaries for refining pig-iron are largely used in Italy, their number being about 200. Charcoal is the principal fuel used in the furnaces, forges, and blomaries, the Appenine forests furnishing the most of it.

"In the island of Elba they are of unsurpassed richness. The iron ores on this island, and in other parts of Italy, were used long before the Christian era. There are three principal iron districts in Italy additional to Elba — Lombardy, Piedmont, and Tuscany. In all Italy there are about 40 blast furnaces, many of which, owing to the scarcity of fuel, have not recently been in operation.

"There are yet in operation in the United States 64 Catalan forges, for the direct conversion of iron ore into wrought iron; these forges are mainly in New York and Tennessee, and in the former State they are wholly engaged in the production of iron for the manufacture of steel." — *Morrell.*

Saranac . . . . . "*Iron Age*," xviii., Sept. 7, p. 9.
* "*Scientific American Sup.*," 628

See also TROMPE.

Cat'a-ma-ran'. 1. A fishing raft used on the Coromandel coast of India. The name signifies "tied-trees," and correctly describes the raft made of 4 or 5 pieces of timber 6′ or 7′ long lashed together to form a width of 2½′, narrowed to a point at one end. The fisherman kneels, and sits on his heels, as shown at Fig. 1186, p. 502, "*Mech. Dict.*"

2. The name has been applied to other craft, especially used on the Hudson River, and in New York harbor. These vessels have twin hulls united, and carry a cloud of canvas, being remarkably staunch.

3. A steam twin vessel similar to the last described, except in the means of propulsion and the necessary appendages of each respectively.

* "*Scientific American Sup.*," 3911.
Malay rig . . . * "*Scientific American Sup.*," 1860.
Herreshoff . . . * "*Harper's Weekly*," July 27, 1878.
N. Y. Yacht Club, "John Gilpin."
* "*Scientific American Sup.*," 1661, 1679.
Steam . . . . * "*Manufacturer & Builder*," xii. 177.

Cat'a-ract In'stru-ment. (*Surgical.*) Knives, needles, scissors, forceps, scoops. Specifically, —

The Figures refer to *Tiemann's* "*Armamentarium Chirurgicum*," Part II.

	Figs.
Cataract knife	113–115.
Cystotome, for lacerating the capsule	116, 117.
Linear knife	118, 129, *b*, *c*.
Traetor	119.
Lens scoop	120, 125, *b*, *c*.
Lens spoon	121.
Hooked needle	122.
Cataract scissors	126.
Bistoury, for enlarging the section	127.
Iridotomy scissors	127, *b*.
Keratome scissors	128, *b*.
Forceps needle, for false membranes	129.
Iris forceps	130, 131, 141, *c*.
Knife needle	132.
Iris knife	134, 135, 141.
Iris scissors	137, 139, 141, *b*.
Canulated forceps	140
Stop needle	142.
Cataract needle	143–145.
Grooved needle, for soft cataract	147.
Tattooing needle, for coloring white spots on the cornea	148–150, *b*.
Soft cataract exhauster	151, 152.
Canulated needle	138.
Lens forceps	140, *b*.

Ca-tarrh'al Douche. (*Surgical.*) A syringe for irrigating the fauces.

Fig. 364 *d*, p. 90, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

See, also, Fig. 3297, p. 1512, "*Mech. Dict.*"

Cat Boat. A small boat, with a triangular sail, without yard or gaff.

A very common rig of fishing-boat, but also known among pleasure-boats of small and medium size.

They may have one or two masts. See models Nos. 12,099, 25,026, 29,537, 26,585 in the U. S. Fishery Museum.

See, also, "*Scientific American Supplement*," * vi. 2114.

Catch'all. A tool, Fig. 565, for withdrawing from drilled wells broken tools or bars which may have fallen in. Several forms are shown in Plate LXXIV., p. 2756, "*Mech. Dict.*"

Catch Hook. A tool used in hauling pipe. It is pushed into the pipe, the tongue lying flatly on the shank. When the team is hitched to the stem, the tongue is lifted to catch against the inside and prevent retraction. Fig. 566.

Fig. 565.

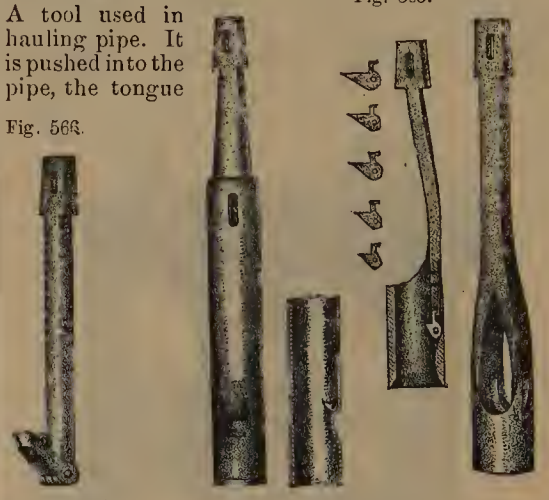


Fig. 566.

Catch Hook. *Catchalls.*

Cath'e-ter. (*Surgical.*) A tube for drawing off a liquid. The word is principally applied to urethral and Eustachian instruments. See Fig. 1190, p. 504, "*Mech. Dict.*"

The specific names refer to shape, material, application, etc.

Compound.	Soft rubber.
Double current.	Velvet-eye.
Eustachian.	Vuleanized.
Prostatic.	Sigmoid.

The surgeon's case also contains catheter holders, catheter syringes. The insulated catheter electrode is for electrization of the male genital organ. Fig. 379, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

"The flexible metallic catheter is without eyes. The base is a hollow silver tube which continues for 4″; the metal is then twisted spirally, diminishing gradually, till it terminates in a point not more than 1-32″ diameter. Through the center a strong wire is passed, the point terminating in a small steel bend which is riveted to the wire. When the instrument is to be introduced, the wire is drawn tight, bringing the bend up to the point and protecting the membranes as the catheter passes through. After the bladder has been entered, the wire is pushed forward, and the urine can flow freely through every portion of the spiral tube."—*Dr. J. H. Thompson's* Report on Group XXIV., p. 63; vol. vii. "*Centennial Exhibition Reports.*"

Tiemann's "velvet-eye" catheter has a perfectly smooth eye, avoiding the irritation due to the use of *Nelaton's* and those of *Jacques'*, the eyes of which are punched.

Cath'e-tom'e-ter. An instrument invented by *Dulong & Petit*, and employed in physics to measure the vertical distance between two points.

Described on page 504, "*Mech. Dict.*" An illustration may be found, if desired, on page 146, *Deschanel's* "*Natural Philosophy*," Part I., American edition.

Prof. Mayer's cathetometer, * "*Sc. Amer. Sup.*," iii. 1221

Ca'tion. (*Electricity.*) The product which is

evolved at the zinc pole in a voltaic battery. The positively charged molecules in a voltaic battery. — *Gordon.*

Anion is the product which is evolved at the copper pole of a voltaic battery. The negatively charged molecules in a voltaic battery. — *Gordon.*

Cat'ling. (*Surgical.*) A delicate concave curved amputating knife.

Cat Rig. (*Nautical.*) See CAT BOAT.

Cat'tle Car. (*Railway.*) A car for live stock. A *stock*-car. Among the various kinds may be mentioned: —

Double deck, for sheep and hogs.
Single deck, for cattle and horses.
Combined cattle and box car, convertible into either.
Box cattle-car, with grated windows, closing in cold weather.
Slat cattle-car, open sides for air in warm weather.

Feeding *en route*, *Tingley* . * "*Railroad Gazette*," xxiv. 436.
* "*Manuf. & Builder*," xii. 172.
* "*Scientific Amer.*," xliii. 374
Walter . . . . . * "*Scientific American*," xl. 407.

Caun'ter Lode. (*Mining.*) A lode which forms a considerable angle with others in the vicinity.

Caus'tic Hold'er. (*Surgical.*) A staff or cup to hold and apply caustic to a deep-seated part.

Caustic probes, and caustic syringes are instruments for the like application in specific manners.

The use of the electric cautery has to a large extent superseded the devices used in potential cautery.

The figures refer to *Tiemann's* "*Armam. Chirurgicum.*"

The caustic holder may be like a porte-crayon to hold the stick of luna caustic, Figs. 154 *b*, 159 *b*, 155, Part I.; Fig. 45, Part III.

Or a scoop . . . Fig. 200, Part II.
Or a brush . . . Fig. 349, Part II.
Or a tube . . . Fig. 345, Part II., 49, 365, Part III.
Or a probe . . . Fig. 346, Part II., 310, Part III.
Or a forceps . . Figs. 286, 297, 298, 577, Part III.
Or a syringe . . Figs. 54, 366, Part III.

Cau'ter-y. (*Electricity.*) A burning instrument usually consisting of an electro-resisting wire or band of platinum, used in surgical operations instead of the heated spatula. See also ELECTRIC CAUTERY.

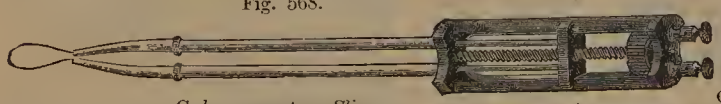
Fig. 567 is Dawson's universal electrode for galvanic cautery operations. The various attachments constitute it a

Fig. 567.

Dawson's "Universal" Cautery Electrode.

cautery écraseur, cautery knife, needle, applicator, etc. As an écraseur in the principal instance, Fig. 567 *A* is a solid hard rubber handle, through which pass the conducting rods *CC*, connected with the conducting wires at *B*. The rods *CC*, being hollow half their length, admit of the rods running from the ivory tip *E* to slide in and out like a telescope, which they are made to do by turning the small wheel *F*. This telescoping of the rods keeps up perfect current connection, and at the same time causes a slow contraction of the wire cautery loop at *E*, the ends of the wire being secured in the ivory clamps *G* on the rods *CC*. The current is regulated or cut off and on from the battery by the screw *D*.

Fig. 568.



Galvano-cautery Sling.

Either of the three smaller instruments is used by withdrawing the tip with its rods and adjusting the substitute into the open ends of the rods *CC*

In Fig. 568, the loop is formed of flexible platinum wire. By turning the wheel on the handle, the loop is contracted,

Fig. 569.

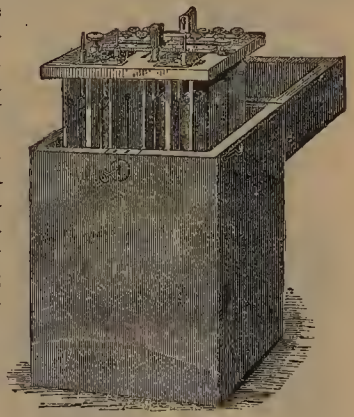
Schroter's Laryngeal Cautery Electrodes.

and, being heated by the battery, cuts the tumor off gradually. The instrument is applied cold, it becomes heated instantly at the moment the circuit is completed, which is done by attaching the wires in the socket at the extremity of the handle.

Fig. 569 shows *Schroter's* electric cautery, for removing laryngeal polypi. No. 1 is a snare of platinum wire; 2 lancet; 3, porcelain burner: 4, knife; 5, *Voltolini's* knife; 6 blunt cautery. Hard rubber handle, sea-horse mounted.

Cau'te-ry Bat'te-ry. A galvanic battery of relatively large electro-motive force and low internal resistance, to be used to heat the platinum wire of a cautery electrode.

Fig. 570.



Cautery Battery.

Cau'ter-y In'stru-ments. (*Surgical.*) The application of actual cautery by the battery has many media; among these are —

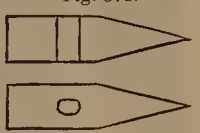
écraseurs.
Moxas.
Scoops.
Knives.
Olives, etc.

See CAUTERY, etc.

Cav'al-ry Bit. One having an extended S check-piece, with a loose ring at the lower end, and a loop above the mouth-piece for receiving the bridle-strap. The check and mouth are solid, the latter being made with or without a port.

Ca'ves-son. (*Manége.*) A portion of the apparatus used in breaking a colt, the main feature of which is the nose-piece, which is buckled around the nostrils, having a long rein attached, and by which a colt is controlled until he becomes accustomed to the bit.

Fig. 571.



Cavil.

Cav'il. (*Stone Working.*) A heavy stone hammer with one blunt face and one pyramidal or pointed peen. It is used in a quarry for rough dressing stones for transportation. Weighs from 15 to 20 pounds.

Cav'i-ty Dry'er. (*Dental.*) A syringe for drying dental cavities with warm air, and removing cuttings and bur-dust from excavations.

The rubber air-bulb is covered with silk netting The other bulb is metallic, and heated over a spirit lamp. In using, the air is expelled, the bulb heated, and the air is then heated by inspiration, and again by expiration as it passes to the tooth.

Fig. 572.

Cavity Dryer.

Ce-les'tial In'di-ca'tor. An apparatus by which the relative positions of the constellations and principal stars are indicated, so as to enable a person to find them by setting the instrument so that its meridian is in a line with the observer and the north star.

Invented by *Mauperin*, * "*La Nature*," reproduced in "*Scientific American Supplement*," * 622.
See also COSMOGRAPH.

Cell. 1. (*Optics.*) A little frame or shallow box to hold or surround a microscopic object; lying sometimes on a slide, and surmounted by a glass cover.

They are made of glass, block-tin, ebonite, etc., and are of many shapes and sizes.

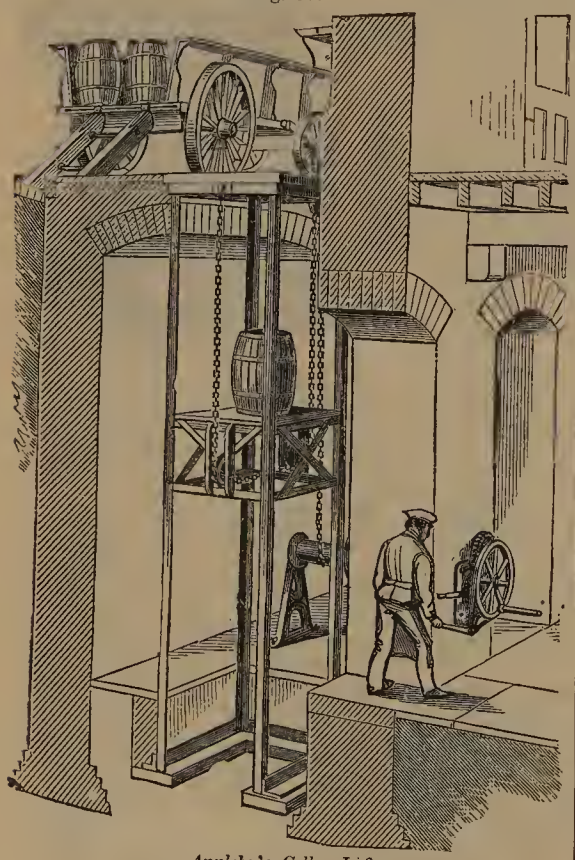
2. (*Electricity.*) A jar or vessel containing the exciting fluid of a battery. See GALVANIC BATTERY.

Cel'lar Crane. A device used in confined situations in streets and warehouses.

The jib of the crane is fixed in the cellar and is made telescopic, so that the load is first lifted from any point within the radius of the crane, and is afterward lifted and carried in a diagonal direction through the doors or flaps until it is high enough to be deposited in the street or on a truck.

Cel'lar Lift. A hoist for raising or lowering

Fig. 573.



Appleby's Cellar Lift.

goods to or from the pavement and the cellar. It works vertically in guides, or on the incline of a ladder, according to convenience.

It is shown in the act of lowering, the man holding the brake.

Cell Cut'ter. A tool for cutting cells out of thin wax: it resembles a wad cutter; any circular tube with a sharp edge will answer the purpose.

Cel'lu-loid. A product having pyroxyline or soluble gun-cotton as its base. A substitute for hardened caoutchouc. Inflammable and dangerous.

Parkesine. Pyroxyline incorporated with linseed oil. Used for knife handles, etc. Named after the English inventor, Mr. Parkes.

Celluloid. Pyroxyline and camphor: —

A solution containing about equal parts of camphor and tetrachloride of carbon, dissolves or softens pyroxyline very readily; and if such a solution is incorporated with a sufficient proportion of the soluble nitro-cellulose, a dough-like mass is obtained, which hardens on the evaporation of the tetrachloride of carbon; but the material may be again made plastic and workable by being heated to a temperature between 100° and 125° Centigrade.

Or: the materials may be mixed mechanically at a regulated temperature.

Or: the camphor may be dissolved in carbon di-sulphide, liquefied sulphurous acid, or other solvents.

Parkes process: Nitro-cellulose softened in alcohol and forced into molds under pressure.

The business in this country is understood to be practically under the Hyatt patents, and celluloid made of fine tissue paper and camphor treated with chemicals by the patented process. The material is made by the company and sold to parties to make into various articles, the price being graduated according to the ability of the article to stand a given price. The material, while of one quality, is, for instance, 60 per cent. cheaper for umbrella-handle making than for jewelry.

Celluloid may be any color, or mottled. Imitations of ivory, coral, ebony, horn, tortoise-shell, porcelain, malachite, amber, are easily made.

Celluloid, in its use as a substitute for ivory, has already exercised a great effect upon the ivory industry.

This composition is used for: —

Billiard balls.	Pocket-books.
Combs.	Mouth-pieces for pipes.
Backs of brushes.	Cigar-holders.
Hand mirrors.	Musical instruments.
Toilet articles.	Doll heads.
Whip and cane handles.	Porcelain imitations.
Umbrella handles.	Hat bands,
Harness trimmings.	Neckties.
Foot rules.	Optical goods.
Chessmen.	Shoe tips and insoles
Knife and fork handles.	Thimbles.
Pencil cases.	Emery wheels.
Dental plates.	Shirt cuffs.
Jewelry.	Collars, etc

The French process is thus given in the "*Bull. de la Soc Industrielle de Rouen:*" —

"Paper is treated by a continuous process with 5 parts of sulphuric acid and 2 of nitric acid, which convert it into a sort of gun-cotton. The excess of acid is removed by pressure, followed up by washing with abundance of water. The paste when thus washed, drained, and partially dried, is ground in a mill, mixed with camphor, ground again, strongly pressed, dried under a hydraulic press between leaves of blotting-paper, cut, bruised, laminated, and compressed again in a special apparatus suitably heated. It is said to be hard, tough, transparent, elastic, fusible, becoming plastic and malleable at 125° C. It ignites with difficulty, is decomposed suddenly at 140° C. without inflammation, and gives rise to reddish fumes. It is inodorous, and does not become electric on friction."

Other compositions of various materials may be found as follows: see also list under COMPOSITIONS.

Bone-silate.	Ebonite.
Bois-durci.	Eburine.
Boulinikon.	Ebony, artificial.
Coral, artificial.	Ivory, artificial.
Cellulose.	Hemacite.

The following list includes the United States Patents, 1867, to January 1, 1881, on celluloid and allied compounds: collodion, pyroxyline, xyloidine. Processes, apparatus, and applications: —

65,267	*Pierson*, Plastic compound of vegetable fibres.
77,304	*McClelland*, Plastic for dental plates.
79,261	*Seely*, Solidified collodion.
81,089	*Hulbert & Follett*, Fabric coated with collodion.
86,841	*Kendall & Trested*, Coating of fabrics with celluloid.
88,228	*Streeter*, Veneering articles with pyroxyline.
88,229	*Streeter*, Dentists' flasks.
*88,260	*Streeter*, Compound for dental plates.
88,624	*Hyatt*, Coating billiard balls.
*88,633	*Hyatt*, Compound for artificial ivory.
*88,634	*Hyatt*, Coating billiard balls.
89,253	*Streeter*, Dental plate.
89,254	*Streeter*, Treating pyrole, pyroxyline, etc.
89,582	*Hyatt & Blake*, Ivory dust, etc., compounded.
*90,765	*McClelland*, Celluloid dental plate.
90,766	*McClelland*, Treating collodion.
91,341	*Hyatt & Hyatt*, Solid collodion.
91,377	*Spill*, Xyloidine compound.
91,378	*Spill*, Telegraph wire insulator.
91,393	*Whitehouse*, Xyloidine insulator.
90,765	*McClelland*. Dental plate.
90,766	*McClelland*, Machine for treating collodion.
93,076	*Hill*, Dental plate.
96,132	*McClelland*, Forming collodion articles.

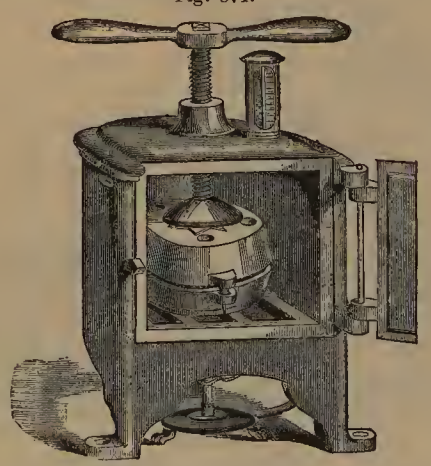
3,777 (Reissue) *Mc Clelland*, Collodion compound.
3,778 (Reissue) *Mc Clelland*, Material for dental plates.
97,454 *Spill*, Dissolving pyroxyline.
101,175 *Spill*, Manuf. of xyloidine, etc.
105,338 *Hyatt & Hyatt*, Molding pyroxyline. (Reissue, 5,928.)
105,823 *Mc Clelland*, Coating objects with collodion.
113,055 *Hyatts & Perkins*, Pyroxyline dental plates.
113,272 *Deitz, Wayne & Stone*, Billiard balls.
113,735 *Brockway*, Molding apparatus.
113,736 *Brockway*, Dental plates.
114,242 *Winsborough*, Pyroxyline for dental plates.
114,945 *Hyatt*, Billiard balls, handles, etc.
119,710 *Hyatt*, Inlaying.
120,130 *Troutman*, Attaching teeth to plates.
121,522 *Hyatt & Hyatt*, Molding dental plates.
125,979 *Newton*, Attaching pyroxyliue base to teeth.
126,575 *Pursell*, Apparatus for attaching teeth to base.
127,656 *Smith*, Composition for dental plates.
128,729 *Hyatt & Hyatt*, Enameling, checkers.
133,229 *Hyatt & Hyatt*, Apparatus for making pyroxyline.
133,969 *Dietz & Wayne*, Manufacture of pyroxyline.
135,918 *Hyatt & Hyatt*, Toilet combs.
136,735 *Jones*, Truss pads.
138,254 *Hyatt*, Manufacture of pyroxyliue articles.
143,772 *Mc Clelland*, Collodion compound.
143,865 *Anthony*, Preparing soluble cotton.
150,722 *Smith*, Artificial coral.
152,232 *Hyatt*, Apparatus and process celluloid.
153,196 *Hunt*, Molding celluloid for dentists.
156,352 *Hyatt & Hyatt*, Solidified collodion.
156,353 *Hyatt & Hyatt*, Manufacture of celluloid.
156,354 *Hyatt & Hyatt*, Factitious ivory.
162,128 *White*, Dental pots.
162,752 *Hunt*, Softening and molding celluloids.
165,234 *Hyatt & Hyatt*, Grinding mill.
165,303 *Cannon*, Treating celluloid for dental vases.
172,995 *Greening*, soluble gun cotton.
173,865 *Reagles*, Composition for dental plates.
176,153 *Pitman*, Celluloid boat.
184,481 *Sweeney*, Graphite aud collodion lubricant.
195,010 *Hyatt*, Brushes.
199,908 *Hyatt*, Celluloid, sheets of.
199,909 *Hyatt*, Celluloid combs.
200,939 *Sanborn*, Cuffs, collars, etc.
201,348 *Hyatt & Hyatt*, Imitations of celluloid.
202,441 *Hyatt*, Coating with celluloid.
203,631 *Lockwood*, Martingale rings, coated with celluloid.
203,838 *Hyatt*, Shoe-tips.
204,227 *Hyatt*, Covering cores and tubes of celluloid, etc.
204,228 *Hyatt*, Tubes, etc., of celluloid.
204,229 *Hyatt*, Apparatus for coating bars with celluloid.
205,271 *Hyatt*, Sheets of celluloid, etc.
205,880 *Lockwood*, Strips for coating articles.
208,584 *Fontayne*, Ornamenting glass.
210,611 *Hyatt*, Apparatus manuf. nitrocellulose.
210,612 *Hyatt*, Apparatus for washing pulp.
210,780 *Hyatt*, Piano keys.
212,948 *Kanouse*, Sweat band for hats.
214,665 *Kays & Hulsey*, Lathe for turning celluloid.
216,474 *Tribouillet & Besaucele*, Solid collodion.
217,111 *Johnson*, Molding celluloid, etc.
217,232 *Mc Caine*, Treating pyroxyline.
218,019 *Halsey*, Neckties and bows.
218,122 *Hyatt*, Cards and labels of celluloid.
219,218 *Carpenter*, Celluloid taper tubes.
219,235 *Edson*, Drying celluloid.
219,279 *Lefferts*, Pitchers and vessels.
220,386 *Kanouse & Sanborn*, Collars and cuffs.
220,502 *Spencer*, Frames for optical instruments.
221,070 *Hyatt*, Manufacture of celluloid.
221,977 *Sanborn*, Collars and cuffs.
222,229 *Beals & Thomas*, Handles for cutlery, etc.
222,678 *Dobbins*, Celluloid dental vases.
223,311 *Booth*, Combs from celluloid.
224,682 *Halsey*, Thimbles, blanks of celluloid.
229,477 *Schmerber & Arrault*, Grinding and mixing.
230,216 *Arrault & Schmerber*, Nitro-derivatives from cellulose.
232,037 *Hyatt*, Applying vencers of celluloid.
232,095 *Whiting*, Celluloid boxes.
233,076 *Corwin*, Celluloid ornamentation.
233,414 *Hays & Hays*, Celluloid wearing belt.
233,558 *Schmerber*, Treatment of nitro-derivatives of cellulose.
233,558 *Schmerber & Schmerber*, Treating pyroxyline.
233,604 *Deutsch & Kanause*, Drumhead of celluloid.
233,824 *Whittemore*, Crutch top.
233,851 *Hart & Bacon*, Decorating celluloid.
233,878 *Sanborn*, Elastic pressing die.
233,898 *Villiers*, Die for molding thimbles.
234,665 *Fox*, Cuffs and fronts.
234,823 *Trested*, Faucet and gage-cock.
235,932 *Carpenter*, Celluloid tubes.
325,933 *Carpenter*, Celluloid dolls.
235,953 *Lefferts*, Syringes.
235,954 *Lefferts*, Spoons and forks.
235,958 *Otto*, Bougies, pumps, etc.
235,959 *Otto*, Pessaries.

See also the following references: —

Man. & uses . . "*Iron Age*," xxiii., May 22, p. 7; xxiv., Dec. 25, p. 13.
Applications . . "*Iron Age*," xxvi., July 29, p. 7; Aug. 19, p. 13.
Explosions . . "*Iron Age*," xxiv., Dec. 11, p. 20.
Pateut decision . "*Iron Age*," xxv., June 24, p. 5.
Incendiary . "*Iron Age*," xix., May 3, p. 15.
Uses, etc., . . "*Manuf. & Builder*," vii. 219; viii. 206-208; ix. 47; xii. 7, 73, 95, 144.
Emery wheels . "*Manuf. and Builder*," viii. 233; ix. 125.
Printiug plates . "*Manuf. and Builder*," xii. 255.
Paper celluloid . "*Manuf. and Builder*," x. 18.
Preparation of . "*Eng. and Min. Jour.*," xxiv. 208.
Uses, etc. . . . "*Eng. and Min. Jour.*," xxvii. 279, 409; xxviii. 300; xxix. 50.
Priuting Plates . "*Eng. and Min. Jour.*," xxx. 125, 141.
"*Mining & Scientific Press*," xxxii. 166; xxxviii. 23.
Cloute . . . . "*Technologiste*," xxxviii. 346.
Uses. . . . . "*Am. Man. & Iron World*," xxv., May 23, p. 8; xxvi., Jan. 23, p. 13.
Veneers . . . "*Am. Man. & Iron World*," xxvi., July 23, p. 8.
Stereotypes . . "*Am. Man & Iron World*," xxvi., Sept. 3, p. 8.
"*Leffel's Mill. & Mech. News*," ix. 119, 138.
Applicatious . . "*Sc. American*," xxxvii. 147, 204; xl. 225.
"*Sc. American Supplement*," 1101, 3617.
"*English Mechanic*," xxiii. 416.
Parkesine . . "*English Mechanic*," xxvi. 223.
Apparatus . . "*English Mechanic*," S. S. White's Dental Catalogue, * ed. 1878, pp. 56, 335.

Cel'lu-loid Heat'er. A small oven for packing while heating celluloid plates. It has an inner

Fig. 574.



Heindsmann's Celluloid Heater.

and outer chamber, the latter affording a continuous circulatiou of heated air. The bottom is ribbed, and the intercostal space filled with plaster to prevent too rapid heating. The door is hinged. The flask containing the teeth and plate is set in, and a clamp screw set through the top of the heater impinges upou the top of the flask. The plaster of the bottom is heated, and the evaporation produces the moist heat which is desirable in the earlier part of the process.

Cel'lu-lose'. The fiber of vegetables; useful especially in the industrial arts as the foundation material for paper; but also of importance as ingredient in the group of objects of which pyroxyline, celluloid, etc., are examples, and as a material which is saturated with nitro-glycerine to produce explosives, under various names.

Refer to . . . "*Manufacturer & Builder*," x. 231.
"*Scientific American*," xxxv. 41.
"*Scientific American Supplement*," 3341.
Mitscherlich . "*Technologiste*," xxxvii. 76.

Ce-ment'. A material for uniting objects or protecting their surfaces.

The compositions differ greatly, and the term is of so wide a signification that it includes mortar, building cements, sticking compositions of gum or resin in solution, pastes, and badigeon for stopping cracks or hiding faults in work; luting for glass or ceramic tubes and vessels. See also CEMENT, pages 507–509, "*Mech. Dict.*"

Besides the recipes and directions found in the following list, there are numerous varieties known under special names, such as BADIGEON, BÉTON, BRECCIA, CONCRETE, HYDRAULIC CEMENT, MORTAR, POZZUOLANA, SCAGLIOLA, STUCCO, etc., in "*Mech. Dict.*" *et infra.* See list on page 1405 of the work cited.

Acid proof: Melt caoutchouc, and add 6 to 8 per cent. of tallow; stir: add dry slaked lime to bring it to the consistency of paste; then add 20 per cent. of red lead.

Or — To a solution of caoutchouc add twice its weight of raw linseed oil; then an equal weight of pipe-clay.

As a lining of cells to make them acid proof: line them with slats of barytes joined with a cement of —

Caoutchouc	1
Turpentine	2
Pulv. barytes	4

To protect a cork from nitric acid: Soak it in a solution of silicate of soda; when hardened, insert cork, and cover with a paste of silicate of soda and pounded glass; wash with solution of chl. calcium. Good for luting.

For protecting wood from acids, alkalies, and corrosive gases: 6 parts colophony, 3 wood tar, fused together, and 4 parts of brickdust stirred in; apply warm.

To unite metal to glass: Powdered litharge . . . 2
Dry white lead 2

Mix; and work up with linseed oil (3) and copal (1) to a dough. The cement is attached to the metal, the glass pressed on, and superfluous cement scraped off.

Or take — Thick solution of glue 2
Linseed oil varnish 1

Boil and stir.

Or — Rosin 3
Caustic soda 1
Water 5

boiled and mixed with half the weight of gypsum.

For fastening letters on glass: Dilute white of egg with water, and add carbolic acid to prevent decomposition; filter: paint the glass with a badger brush; apply the gold or silver leaf; dry; mark the letters with a stencil; put in a warm bath, and remove with the nail superfluous metal.

To stop cracks in glass: Dissolve casein in cold saturated solution of borax; with this solution paste strips of softened bladder on the cracks; dry.

Strong transparent cement, for glass, wood, porcelain, stone. Rub together in a mortar —

Nitrate of lime	2
Water	25
Powdered gum arabic	20

For glass: 1 part India-rubber, dissolved in 60 parts chloroform: 34 mastic; digested at a gentle heat.

Another: Orange shellac, bruised 4
Rectified spirits 3

Put in a warm place, and shake occasionally till dissolved.

To attach wood to glass: Solution of isinglass in acetic acid.

To attach tin to metal: Mucilage tragacanth. . 10
Honey of roses . . . 10
Flour . . . . . 1 Mix.

Waterproof cement: Gelatine 5
Soluble acid chromate of lime 1

Cover the broken edges, press together, and expose to sunlight.

To attach wood to wood, or to make cracks in wood watertight: Lime clay, and oxide of iron; kept dry till wanted, then mix with water and use.

To stick paper, leather, or wood to metal: To a gill of glue dissolved in water add a tablespoonful of glycerine.

To stick leather to metal: Powdered nutgalls dissolved in 8 parts of distilled water; settle 6 hours and filter. Apply this to the leather. Then take a similar quantity of water and add to it 1 part (by weight) of glue. Let it remain in solution 24 hours. Apply to the metal, which should be roughened and heated.

Lay the leather on the metal and dry under pressure.

Rubber Cement: 1 part India-rubber dissolved in 2 parts linseed oil; add quantity sufficient bole, say 3 parts.

For tortoise-shell, amber, etc.: Equal parts mastic and linseed oil, gently warmed, make a good cement, applied warm.

For uniting wood to wood: Shellac dissolved in alcohol. It is well to interpose gauze or thin fabric between the two surfaces. Or shellac, mastic, and turpentine heated, to which isinglass, in small pieces, is added, may be employed.

Attaching small articles to hard surfaces: Colophony turpentine, yellow wax, with a small proportion of pulverized sealing wax.

For bone, ivory, mother of pearl, etc.: Glue, dissolved in water and quicklime; pulverized chalk may also be employed.

For ivory: Place pure gelatine in a strong solution of alumina. When penetrated by the latter withdraw and use immediately. When dry polish.

For porcelain: White of eggs mixed with solution of glue.

Or: 4 parts pulverized oyster shells, and 2 gum arabic; preserve in a tightly stopped bottle and when required for use mix with white of eggs or warm water to a doughy consistency.

Or: 8 parts well-burnt alabaster gypsum, 2 parts fine gum arabic, mixed with water into a thick paste and 40 to 50 drops oil of turpentine added to each ounce of the compound.

Caseine Cements, for glass, porcelain, stone, and wood: Old cheese rubbed fine and mixed with water, forming a paste to which ¼ part of pulverized lime is added.

Or: 1 part quicklime in water, ¾ pulverized lime or sandstone, 1 pulverized cheese.

Caseine water glass: The caseine is separated from skimmed milk by adding acetic acid, filtering and washing, and is mixed with 6 times its bulk of concentrated water glass.

For artificial meerschaum, coating artificial flowers, etc.: Two to 4 parts of the above is rubbed up with cold borax solution till a thick liquid is obtained that becomes clear on standing. This is useful for stiffening and waterproofing goods.

Water glass cement. For glass, porcelain, earthenware, etc.: Rub together 1 part finely pulverized glass and 2 pulverized fluor spar, add water glass solution till the proper consistency is attained.

For the joints and edges of stone and marble slabs: Water glass, mixed with hydraulic cement to form a thick dough.

For cementing stone, and filling up crevices previous to painting; fresh blood, slaked lime, brick-dust, coal ashes, hammer-slag, and sand in various proportions.

For the joints of water-pipes, etc.: 2 parts fine brick-dust, 2 quicklime, and 2 hammer-slag, made into a dough with lye or hot oil.

For rendering Hessian clay retorts impenetrable: Fresh slaked lime rubbed into concentrated solution of borax; the solution is applied with a brush and after drying the retort is heated until the glazing begins to fuse.

German cement for closing joints of stoves: Clay mixed with water, fresh warm blood, and quicklime; it is applied while hot. A compound of wood ashes, fire clay, and salt mixed with water is also employed.

Iron cement: 5 parts clay, 1 salt, and 15 iron filings. Good to resist heat.

White marble cement: Take 8 parts of resin and 1 of wax, to which, when melted together, add 4 parts of plaster of Paris. This is used while hot. Apply only a thin coating.

Or: Mix 12 parts of Portland cement, 6 parts of slaked lime, 6 parts of fine sand, and 1 part of infusorial earth, and make up into a thick paste with silicate of soda. The object to be cemented does not require to be heated. It sets in twenty-four hours, and the fracture cannot be readily found.

For wood, porcelain, or glass: To a strong solution of gum arabic, 8½ fluid ounces, add a solution of 30 grains sulphate of aluminium dissolved in ⅔ of water.

For outside brick-work: Mix 20 parts clean river sand, 1 of quick lime, and sufficient linseed oil to form a thin paste. This is also useful as a cement for broken stone.

Oil cements. 1. *For porcelain and for luting chemical apparatus:* Fine brick-dust mixed with an equal quantity of red lead and rubbed or ground with old boiled linseed oil; after being applied, sand is strewn upon it.

2. 6 litharge, 4 pulverized fresh burned lime, 2 parts white bole, mixed with cold linseed oil.

3. *For iron water-pipes:* 12 parts Roman cement, 4 white lead, 1 litharge, ½ colophony — pulverize, mix, and triturate 2½ or 3 pounds with old linseed oil, in which 2 oz. colophony has been boiled.

Or: Equal parts lime, Roman cement, and potters' clay, finely ground, sifted, and well mixed with linseed oil.

4. *Common lead luting* is made of litharge and red lead mixed with old boiled oil.

Another is composed of 2 parts red lead, 5 white lead, and 5 fine clay — mix with boiled oil.

5. *For wood:* 1 part pulverized slaked lime and 2 of rye flour, mixed with linseed oil varnish.

6. *To make water-holders tight:* Pulverized slaked lime and cod-liver oil; chemical apparatus may be made tight by oil cake or pressed almond cake, rubbed up with water.

7. 10 parts red lead, 25 white lead, 20 pipe-clay — mix with boiled oil.

Water cement: 10 parts slaked lime, 19 brick-dust, 16 sand, 5 blacksmiths' dross, 5 powdered quick lime — mix with water.

Iron and blood cement: 100 parts pulverized lime, triturated with bullocks' blood, 200 parts cement, and 5 to 10 parts iron filings.

Ce-ment', Plas'ter, Glue, etc.

See under the following heads: —

Alabaster, imitation.	Lime screen.
Amber cement.	Marble, artificial.
Asphaltum, artificial.	Marble cement.
Belting cement.	Marbleizing iron.
Béton.	Marine glue.
Black mortar.	Mixing machine.
Caoutchouc cement.	Mortar.
Carbonated stone.	Mortar machine.
Cement (see list).	Mortar mill.
Cement cask.	Mortar mixer.
Cement mill.	Mouth glue.
Clay mill.	Mucilage.
Clay tempering mill.	Plaster.
Concrete.	Plastering.
Cutler's cement.	Plastering machine.
Distemper.	Plaster mill.
Floor cement.	Portable glue.
Glass cement.	Portland cement.
Glue.	Pozzuolana.
Glutine.	Rust cement.
Glycerine cement.	Sand dryer.
Hammond artificial stone.	Sand screen.
Hydraulic cement.	Sand sifter.
India-rubber cement.	Screen.
Insoluble cement.	Slag cement.
Iron cement.	Stamp mucilage.
Jewelers' cement.	Steam proof cement.
Lamp cement.	Stone, artificial.
Leather cement.	Stone, carbonated.
Lime cracker.	Stucco.
Lime kiln.	Water-proof cement.
Lime mill.	Whitewash.

See the following references to cements: —

Acid proof	"*Scientific Am.*," xxxvi. 213.
Architectural, "*Engineer*"	"*Van Nost. Mag.*," xix. 493.
Bottle sealing	"*Scientific Am.*," xxxix. 231.
Caoutchouc to metal	"*Scientific Am. Sup.*," 454.
Calcimine	"*Scientific Am.*," xxxiv. 394.
Cement-making plant.	
Michèle	* "*Engineer*," xlvii. 186.
Cutlers'	"*Scientific Am.*," xxxvi. 214.
Castings, holes in	"*Scientific Am.*," xxxix. 197.
Cast iron	"*Scientific Am.*," xl. 182.
Glass	"*Scientific Am.*," xxxvi. 213.
	"*Scientific Am.*," xl. 184.
Hydraulic, American	"*Iron Age*," xxv., June 3, 15.
Iron	"*Scientific Am.*," xxxiv. 181.
Insoluble	"*Scientific Am.*," xxxix. 399.
Manufacture, *Goodridge*	"*Man. & B.*," ix. 282.
Metallic to non-metal. articles	"*Scientific Am.*," xxxv. 23.
Metals to glass	"*Sc. Am.*," xl. 104, 243.
Metals to glass windows	"*Scientific Am.*," xxxvi. 25.
Ornaments	"*Scientific Am. Sup.*," 692.
Philadelphia, 1876, at	"*Scientific Am. Sup.*," 1011.
Pipes	"*Engineering*," xxii. 408.
Portland (tests)	"*Scientific Am.*," xxxv. 209.
Making	* "*Man. & Builder*," ix. 32.
Faija	"*Van Nost. Mag.*," xxii. 463.
Adulteration of	"*Van Nost. Mag.*," xxiii. 27.
"*Building News*"	"*Van Nost. Mag.*," xxii. 156.
Sewage dryer, *Wilson*, Br.	"*Engineering*," xxviii. 378.
Tester, *Fairbanks*	* "*Man. & B.*," xii. 280.
Holste, Ger.	* "*Engineering*," xxvi. 163.
Jacob, Br.	* "*Engineer*," xlviii. 397; * xlviii. 438.
Adelaide water works	* "*Engineer*," xlix. 100.
Valuation of, *Michaelis*	"*Scientific Am. Sup.*," 1813.
Waterproof	"*Scientific Am.*," xxxvi. 199.
	"*Scientific Am.*," xxxv. 353.
Wooden baths	"*Scientific Am. Sup.*," 1105

See Report on Cements by Gen. *Q. A. Gillmore*, "*Centennial Exhibition Reports*," Group II., vol. iii., p. 147 *et seq.* Including —

Puzzuolana.	Vicat's cement.
Trass.	Hydraulic lime.
Roman cement.	Artificial stone.
Portland cement.	Phœnix stone.

See also: —

Gilmore's Practical Treatise on Limes, Hydraulic Cements, and Mortars."
Gillmore's "Coignet Béton and Other Artificial Stone."
Reid's "Practical Treatise on Manuf. of Portland Cement."
Reid's "Pract. Treatise on Concrete, and How to Make it."
Austin's "Practical Treatise on Calcareous and Hydraulic Limes and Cements."
Dobson's "Foundations and Concrete Works."
Burnell's "Rudimentary Treatise on Limes, Cements, Mortars, Concretes, Mastics, Plastering," etc.

Ce-ment' Cask. Casks, or rather cisterns of cement have been used in Zurich since 1871, by M. Bollert, for storing wine.

First coat selected portions of the cellar walls roughly with cement-mortar, and then with the best pure Portland cement form the other portions of the vessels by pouring the material into suitably constructed wooden molds. The finished vessels may be similar in external appearance to the wooden ones if desired. After the interior is sufficiently hardened, fill with water for 10 days, to ascertain whether they are tight, and also to extract the caustic ingredients of the cement. The latter object is, however, better accomplished with a solution of carbonate of ammonia and subsequent rinsing with water.

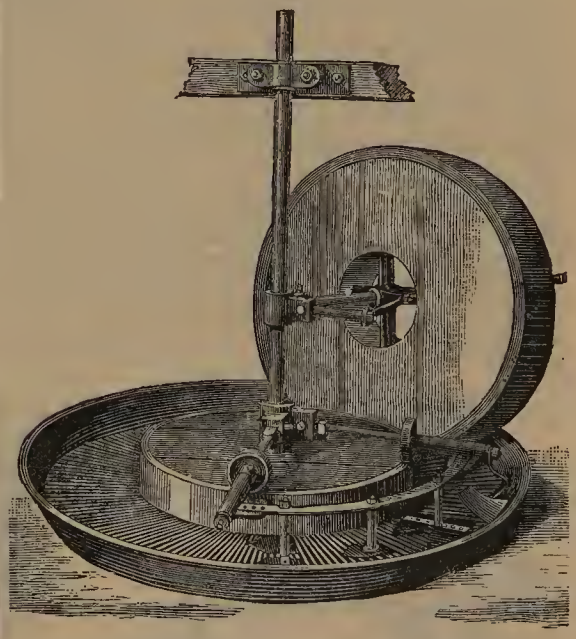
Ce-ment' Mill. 1. A mill for crushing the auriferous gravel cemented with clay found in the placers of California.

One belonging to the New York & Calaveras Mining Company is cylindrical in form, 4I′ long and 6½′ diameter, set on an incline of ½″ to the foot and revolved. Interior flanges break the cement in passing, water being supplied freely and spaces left to allow the crushed cement to pass out. The bowlders and blocks of cement grind against each other in transitu and the cement is degraded.

2. A mill for grinding cement stone to powder suitable for making mortar, béton, etc.

The machine of *Jannot fils*, of Triel (*Seine-et-Oise*), France, has a Chilian edge-stone traversing in an annular pan, and with various scrapers which lift the cement and throw it again and again into the path of the stone. A horse is hitched to the horizontal axis of the stone.

Fig. 575.



Cement Mill. (*Jannot fils, Triel, France.*)

It is used for grinding plaster for building, pozzuolana, charcoal, etc.

Ce-ment' Plug'ger. (*Dentistry.*) An instrument for plugging carious teeth with oxychloride cement.

Fig. 576.

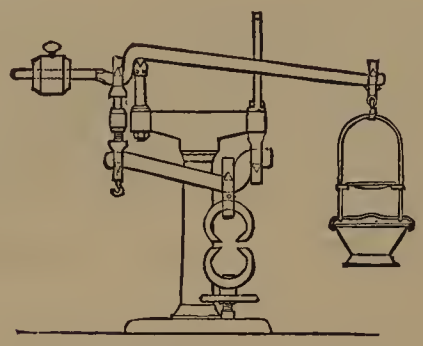
Atkinson's Cement Pluggers.

Ce-ment' Steel. (*Metallurgy.*) Steel obtained by piling bars of wrought iron in a furnace interstratified with charcoal and exposure to heat without access of air. See Figs. 1197, 1198, p. 509; also p. 2364, "*Mech. Dict.*," *Blister Steel.*

Ce-ment' Test'er. A machine for ascertain-

ing the breaking strain, or the crushing resistance of cement.

Fig. 577.

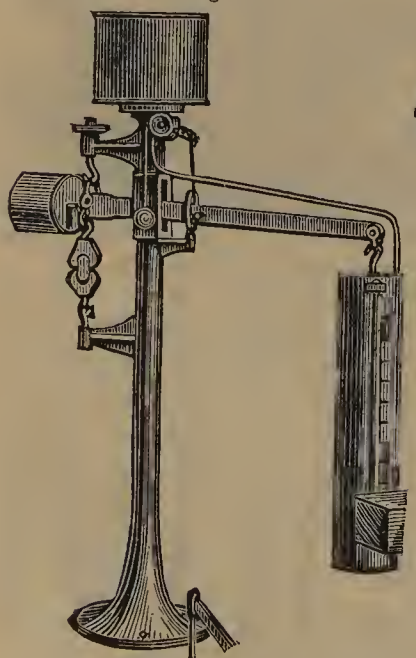


Michaelis' Cement Tester (German).

Fig. 577 shows the apparatus devised by *M. Michaelis*, of Berlin, and which is largely used in Germany.

It has a standard 15″ high, to which are attached two levers, the power of the upper one being 10 to 1, and the lower 1 to 1. The lower lever carries one of the jaws for holding the briquette, while the other jaw is attached to the base plate of the machine, and is vertically adjustable by means of a hand-wheel and screw. From the end of the long limb of the upper lever is suspended a weight-pan, with hooks at the lower end of its framing for carrying a receiver for holding shot. When at rest, the knife-edges of the levers should be on a level, their adjustment being effected by meaus of the counter-weight on the short limb of the upper lever. In operating with this apparatus the briquette is placed in the holding jaws, which are then adjusted by means of the hand-wheel and screw. Fine shot is then poured into the suspended receiver until the fracture of the briquette takes place. The receiver with the shot is then weighed by an ordinary pair of scales, or it may be weighed on the apparatus itself by hanging it on the hook of the connecting link between the two levers, the weights being placed in the weight-pan. Weighing by independent scales, however, is more expeditious. The weight of the receiver and shot, multiplied by 50, represents the tensile strength of the briquette per square inch of sectional area. The apparatus is portable and does not require to be fastened down for use. It is about 23″ high and 25″ long, and only weighs a little over 50 pounds.

Fig. 578.



Bailey & Co.'s Cement Tester (English).

Another machine, on the same principle, is made by Bailey & Co., of Salford, England; but the weight consists of a can, into which water flows from a small reservoir or the summit of the machine. A graduated glass tube indicates the weight of the liquid in the can, and when the cement is broken, a trigger closes the tap and stops the flow of water.

The cement tester of M. Hervé Mangon, constructed for the *Laboratoire des Ponts et Chaussées* of France, is shown in Fig. 579.

The block of cement, molded into the form shown at *B*, is held between two clasps, the upper one of which is suspended from the short arm of the beam and the lower one retained by a rod fastened to the frame of the machine, and capable of adjustment as to length by a hand-wheel, *D*, which screws on the thread of the rod. Weights, *A*, proximately sufficient for the purpose, are placed on the swinging platform, which is suspended from the end of the long lever, and the smaller weight *P* is then advanced along the graduated beam by means of the hand-wheel *C* and the worm, or, for still more delicate movement, by the wheel *C'*, which moves the worm by pinion and cog-wheel.

M. Mangon remarks that mortar formed of cement 1, and sand 2, should not be subjected to test in less than 6 to 10 hours; and that a test-block 0.04 m. on each side at the narrowest part, or 0.16 m. square in cross-section should support, after five days at least, 70 kilos before breaking.

The machine made by *Paupier*, of Paris, is adapted either for traction or crushing.

M. Hervé Mangon speaks as follows of the Portland cement: —

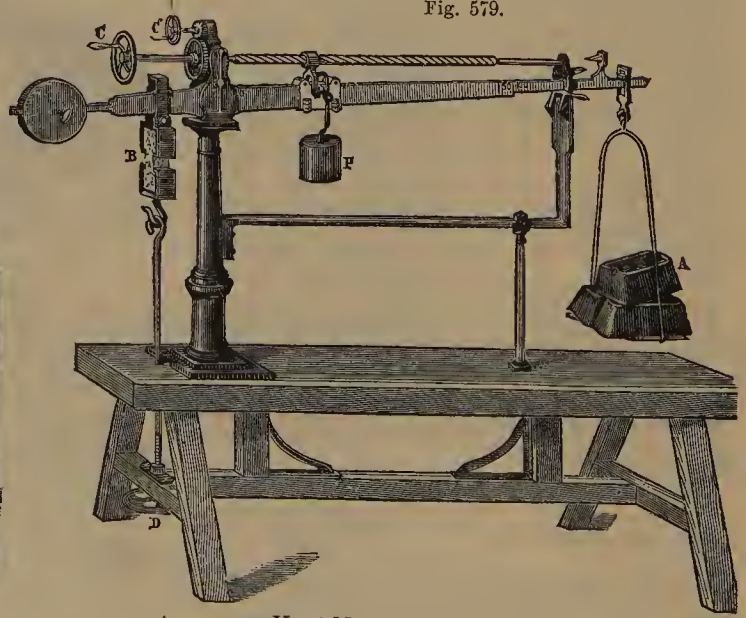
"The applications of Portland cement are extremely numerous. Mortar of cement is about as easily employed as that made from hydraulic lime. Mason-work in Portland cement has a solidity, proof against all tests, and resists even the action of sea-water. With this cement are erected the light and bold arches and vaults which are among the astonishing constructions of the day. It serves to build and line the great reservoirs of the cities. It gives surfaces as fine and moldings as delicate as plaster, with absolute unalterability. It furnishes flagging stones of a durability equal to stone, and a much cheaper rate. It enters into the composition of the *bétons agglomérés* of M. Coignet, employed so extensively in the public works of Paris, and particularly in the construction of the grand aqueduct for conveying the water of the Vanne to Paris."

The hydraulic lime of Teil, France, is said to contain 66 per cent. of silicate of lime, and to form one of the strongest cements known. It is used by the "Fire-proof Building Co." of New York.

The following references may be consulted: —

Holste . . . . . * "*Engineering*," xxvi. 163.

Fig. 579.



Hervé Mangon's Cement Tester (French).

Michaelis . * "*Scientific American Supplement*," 3748, 2335.
"*Van Nostrand's Engineering Mag.*," xvii. 17.
Richle . . * "*Manufacturer and Builder*," xi. 108.
Fairbanks . "*Manufacturer and Builder*," xii. 280.
* "*American Railroad Journal*," xlix. 667.
Bailey . . "*Scientific American*," xxxviii. 130.

Cen'ter Bear'ing. (*Railway.*) The bearing for a car on the center of the truck frame. The *body center-plate* rests on the *truck center-plate d*, Fig. 1159, p. 488, "*Mech. Dict.*," and *N*, Fig. 1161, p. 489, *Ibid.*

See also pp. 242–247, **Forney's "Car Builder's Dictionary."*
Center Plate, "*Railroad Gazette*" . . * xxii. 409.

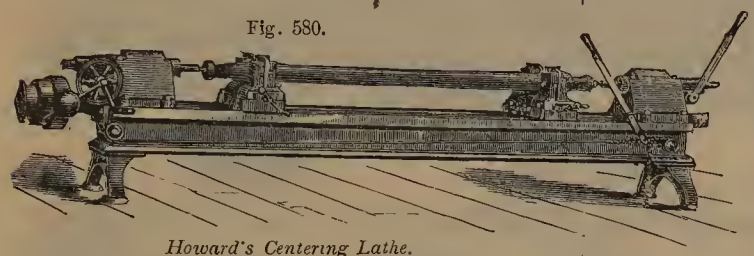
Cen'ter Board. A board lowered on the longitudinal central line of a boat, acting as an extension of the keel, to keep the vessel from drifting to leeward when under canvas.

Roller center board, . * "*Scientific American Sup.*," 2126.

Cen'ter-ing Lathe. A machine-tool for centering car axles and shafting, at both ends at the same time. It has a long bed, head and tail stock, and two rests, with adjustments vertical and lateral.

Centering tool . . . * "*Scientific American*," xl. 100.
Lathe attachment, *Brown*, * "*Scientific American*," xliii. 326
Chuck. . . . . * "*Scientific Amer.*," xxxviii. 210.

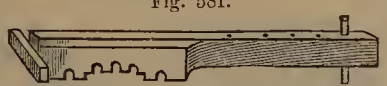
Fig. 580.



Howard's Centering Lathe.

Cen'ter-mold. A templet sweeping upon a center, and used to make circular moldings in plaster, such as those around rosettes on ceilings.

Fig. 581.



Center-mold, for circular ceiling ornaments.

Cen-tes'i-mal Al'co-hol'me-ter. An instrument by *Gay Lussac* for testing the relative quantity of alcohol in a solution of the same. It has a glass spindle, scale 0° to 100°, each degree showing 1 per cent. by volume of pure alcohol of sp. gr. 0.795, in any mixture of spirit and water, at the temperature of 15° Centigrade, or 59° F.

Tralle's alcoholmeter also has centesimal graduation.

Cen-tes'i-mal Scale. 1. A scale in which the poise and the object bear the relation 1 to 100.

2. A scale graduated in hundredths. The French meter; the Centigrade thermometer, invented by Celsius; and the Gay Lussac alcoholmeter, are instances.

Cen-trif'u-gal Ma-chine'. Called also *Dryer, Wringer, Hydro-extractor, Centrifugal Filter, Sugar Dryer*, etc.; under all or some of which heads it is noticed in the "*Mech. Dict.*," *et infra.*

* "*Scientific American Supplement*," 455.
* "*Scientific American*," xxxiv. 147.
Maumené, Fr., * "*Dept. Agric. Report*," Special 28, Plate xxix.

Cen-trif'u-gal Pump. The term *rotary* is usually applied in America to those which have rotary pistons, and the term *centrifugal* to those of the *Gwynne* and *Appold* class.

Rotary pumps, preserving this distinction, are illustrated by 17 Figs. 4465, 4466, pp. 1988, 1989, "*Mech. Dict.*" In Fig. 4466 are also one centripetal and four centrifugal pumps. The rotary blowers, p. 1985, and rotary steam-engines, p. 1991, *Ibid.*, are many of them exactly similar in construction.

Fig. 1216, p. 515, *Ibid.*, illustrates some of the forms of *centrifugal pumps*, and among them the pump of Cogniard (*C*, Fig. 1216), as shown at the Paris Exposition of 1867.

Attention has of late been much drawn to the centrifugal pump for draining and wrecking purposes, cases involving the lifting of large bodies of water to a moderate height, and the French have exploited the systems of Appold and Gwynne, the English engineers of most prominence in this line. Cogniard at Paris, Malo-Belleville at Dunkerque, and Dumont & Neut at Lille, are among the principal Continental manufacturers in this line.

Gwynne of Hammersmith, England, has built at Codigoro, near Ferrara, a set of immense centrifugal pumps for the purpose of draining the Ferrara marshes of Italy, which cover an area of 200 square miles, and from which they are expected to be capable of lifting 2,000 tons of water per minute to a height of 12′ as a maximum. The mean lift will be 9′ 3″. Eight pumps are to do this work. They are arranged in pairs, each pair driven by a compound engine. The diameter of the disks of the pumps is 5′, that of the pipes 4½′. The casing is 15′ in diameter. The driving-engines have cylinders 27¾″ and 46⅝″ diameter, with a stroke of piston of 2½′. The cylinders are steam-jacketed. The cranks are so placed as to make an angle of 130° with each other. Surface-condensers are used of 750 square feet of cooling-surface each. Steam is supplied by ten boilers, each having 30 square feet of grate and 730 square feet of heating-surface. These are probably the largest centrifugal pumps, and the whole constitutes the most powerful set of pumping apparatus ever constructed.

The capacity of each of the 8 pumps at the mean lift of 7′ 3″ is 57,000 gallons per minute; the aggregate 456,000 gallons per minute or 656,640,000 gallons per day of 24 hours. This is about 6 times the supply of London, 6 times the capacity of the Croton aqueduct, and double the quantity passing down the Thames above Hampton Court.

A model of the Codigoro pumps was shown at the Centennial Exhibition, 1876.

The drainage pumps of the Haarlem Meer, South Holland, are shown on pp. *116, *739, *1830, "*Mech. Dict.*" These engines are 3 in number, and raise 2,000,000 tons of water per 24 hours, a maximum height of 17.75 feet.

The Heald and Sisco centrifugal pump, exhibited in Philadelphia in 1876, has two forms: A concave arm piston and a hollow arm piston. In the latter case the piston may be described as a wheel having four curved box-shaped hollow spokes, through which the water is drawn from the center through a hollow journal and forced out at the periphery of the wheel. Between the outer face of the latter and the walls of the shell there is a space which gradually widens as the water approaches the exit until it attains the full dimensions of the discharge pipe.

The Andrews centrifugal pump, also shown in Philadelphia, is illustrated at *F*, Fig. 1216, p. 515, "*Mech. Dict.*" Gwynne's at *A*, Coignard's at *B C*, same Fig.

The Enterprise Hydraulic Works (Phila.) pump is under Alden's Patent, April 18, 1848, No. 5513. It has a cast-iron volute-shaped case, in which rotates a disk that has curved tapered wings bolted to each side.

MM. Dumont & Neut's later improvements in this line are shown in Fig. 582, which is a central vertical section and partial elevation. The improvements particularly concern the withdrawal of air which collects at the apex of the turbine chamber and which is a cause of diminution of effectiveness and frequently of stoppage; the latter particularly in cases where the lift is moderate and air is apt to enter at the inlet which may not be entirely submerged at all times. In some cases the air gathers in the center of the turbine where the pressure is least and throws the pump out of action. M. Cogniard devised a plan for removing the air from the center of the turbine by means of a small pump, but the device shown in Fig. 582 is considered more simple and efficacious.

It frequently happens in drainage operations, that air enters at the foot valve of the induction pipe. In this case a communication is established between the circumferential chamber and the center of the turbine by openings *s s′*. When a certain quantity of air is introduced into the turbine it escapes in part by virtue of its levity at these openings, but a portion remains around the central axis. When a quantity of air has thus accumulated, the openings *s s′* eject jets of water at high pressure and drive the air into the vortex of water with which it passes to the eduction pipe, or rising into the apex of the chamber is withdrawn by faucet at the foot of the vase *J*.

The stuffing box is in two parts *o o′*, with a metallic ring *c*, and water from the turbine chamber reaches the journal by pipes *q* and holes *p p*.

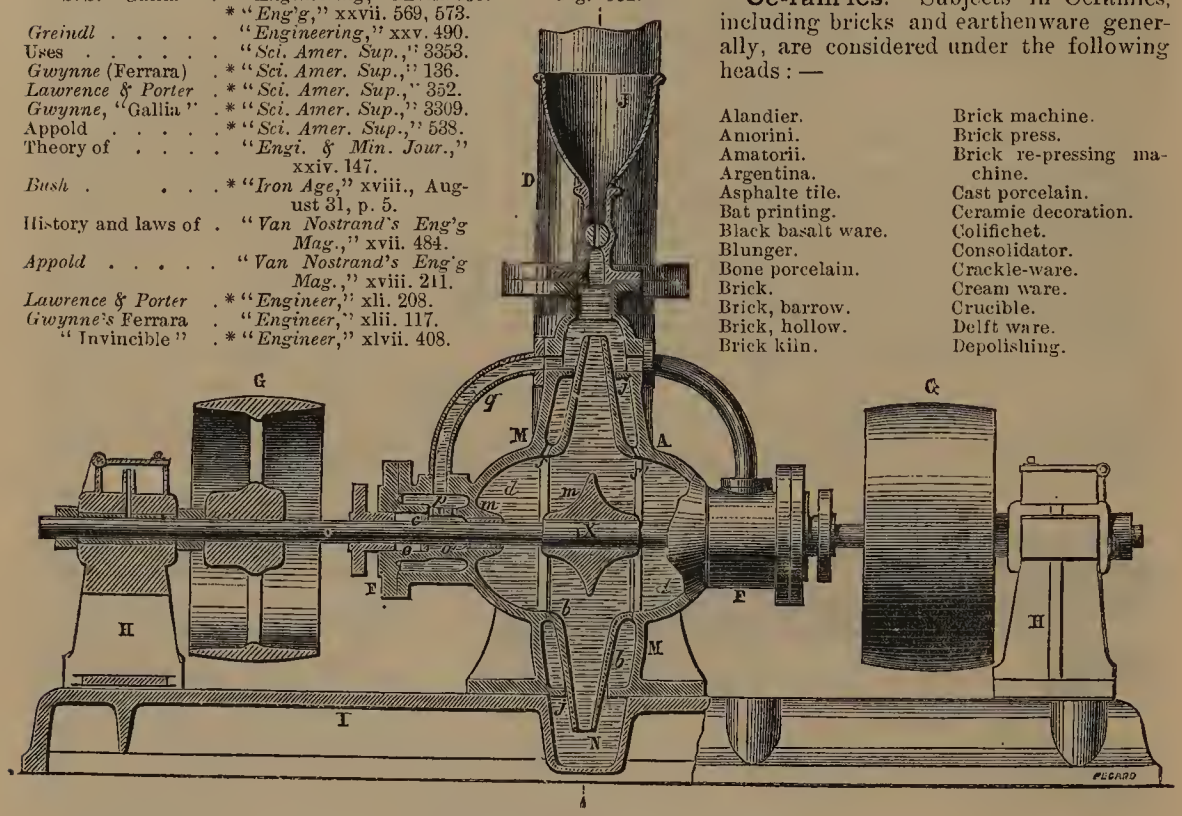
D is the discharge pipe; *G G* the driving-belt pulleys; *H H* the standards of the pillow blocks; *I* the bed plate; *F F*, the stuffing boxes; *A M*, the case of the turbine *N b*.

The following references may be consulted: —

Brotherhood . . . . . * "*Engineering*," xxi. 532.
Gwynne . . . . . * "*Engineering*," xxi. 8, 9, 12.
(Ferrara Marshes) . . * "*Engineering*," xxv. 60, 62.
(Dordrecht) . . . . * "*Engineering*," xxi. 192–197.

S. S. "Gallia"	* "*Engineering*," xxviii. 450.
	* "*Eng'g*," xxvii. 569, 573.
Greindl	"*Engineering*," xxv. 490.
Uses	"*Sci. Amer. Sup.*," 3353.
Gwynne (Ferrara)	* "*Sci. Amer. Sup.*," 136.
Lawrence & Porter	* "*Sci. Amer. Sup.*," 352.
Gwynne, "Gallia"	* "*Sci. Amer. Sup.*," 3309.
Appold	* "*Sci. Amer. Sup.*," 538.
Theory of	"*Engi. & Min. Jour.*," xxiv. 147.
Bush	* "*Iron Age*," xviii., August 31, p. 5.
History and laws of	"*Van Nostrand's Eng'g Mag.*," xvii. 484.
Appold	"*Van Nostrand's Eng'g Mag.*," xviii. 211.
Lawrence & Porter	* "*Engineer*," xli. 208.
Gwynne's Ferrara	"*Engineer*," xlii. 117.
"Invincible"	* "*Engineer*," xlvii. 408.

Fig. 582.



Dumont & Neut's Centrifugal Pump.

Gwynne, Ferrara	"*Scientific American*," xxxiv. 129.
	"*Scientific American*," xxxviii. 246.
Heald & Sisco	* "*Min. and Sci. Press*," xxxiv. 369.
Poillon	"*Technologiste*," xxxix. 305.

Thurston's "Vienna Report," 1873.

Gwynne. London	ii., 195.
Bernay. London	ii., 197.
Neut & Dumont. France	ii., 197.
Coignard. France	ii., 198.
Nagel & Kaemp. Hamburg	ii., 198.
Scheile. Germany	ii , 199.
Boulton & Imray. Britain	ii., 199.

Cen-trif'u-gal Screw. The centrifugal screw has many applications in CENTRIFUGAL PUMPS and VENTILATORS. See under those heads. The screw propeller itself has many features in common with the centrifugal pump, and though now it acts free in the sea, in one of the early forms (*Ericsson's*) the screw acted in a cylindrical trunk. Shaw's propeller pump is shown in Fig. 3977, p. 1810, "*Mech. Dict.*" On pages * 516, 517, are other illustrations of the same principle, and on p. * 2073, *Ibid.*, the same feature is shown as applied to a marine governor; the screw working in a resisting medium is employed to regulate the throttle valve of a propeller engine. The pulley shaft is driven by a belt connection with the engine, and the apparatus is so adjusted that any excess of speed translated by the propeller shaft to the screw in the governor, partially closes the throttle.

Screw ventilator. *Pelzer* . . . . * "*Sc. Am. Sup.*," 4073.

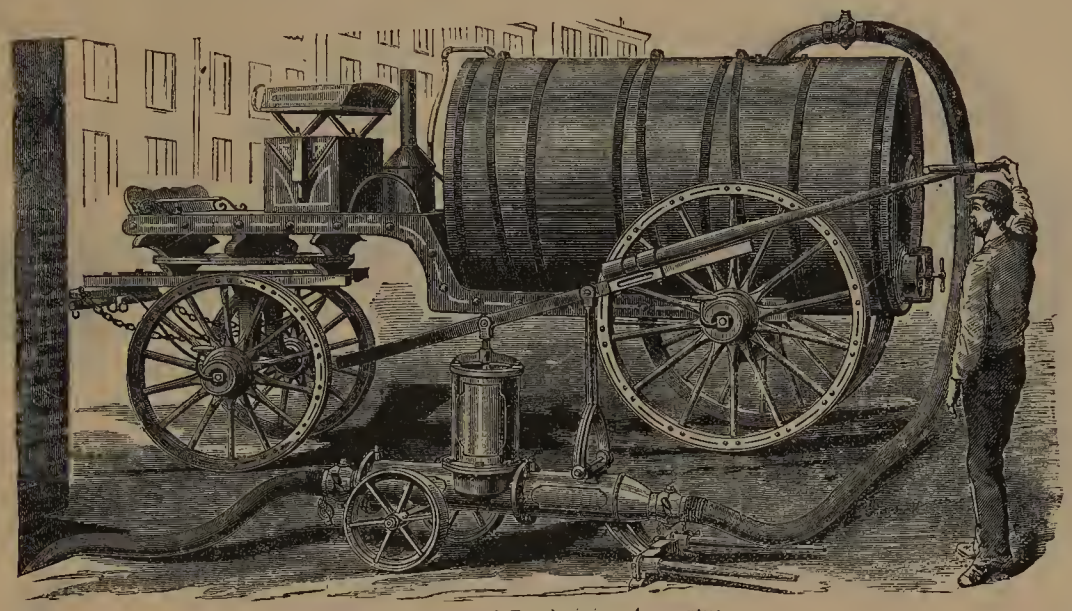
Cen-trip'e-tal Rail'way. It consists of a central or bearing rail, and lateral steadying rails. The running stock has double-flanged wheels bearing upon the central rail, and wheels without flanges on the side-rails. Each set of wheels has a separate and independent axle, and all are arranged to have a swinging and lateral, as well as perpendicular motion, each independent of the other. — *Buzby.*

Ce-ram'ics. Subjects in Ceramics, including bricks and earthenware generally, are considered under the following heads: —

Alandier.
Amorini.
Amatorii.
Argentina.
Asphalte tile.
Bat printing.
Black basalt ware.
Blunger.
Bone porcelain.
Brick.
Brick, barrow.
Brick, hollow.
Brick kiln.
Brick machine.
Brick press.
Brick re-pressing machine.
Cast porcelain.
Ceramic decoration.
Colifichet.
Consolidator.
Crackle-ware.
Cream ware.
Crucible.
Delft ware.
Depolishing.
Dipping vat.
Doulton ware.
Drain-pipe machine.
Drain tile machine.
Drying room.
Earthenware.
Egg-shell ware.
Electro-plating china.
Enamel.
Enameling.
Encaustic.
Encaustic tile.
Etching.
Faïence.
Faïence d'Oïron.
Faïence stannifère.
Fire brick.
Flint brick.
Flooring tile.
Frit.
Frit furnace.
Frit mill.
Glaze.
Grafito.
Grand feu.
Granite ware.
Green ware.
Handling.
Hard paste.
Henri-deux ware.
Iron-stone china.
Ivory paste.
Ivory porcelain.
Jasper ware.
Kiln.
Luster
Majolica.
Mezza-majolica.
Mixed clay ware.
Mixing mill.
Modeling clay
Mold.
Muffle.
Mural tile.
Oïron ware.
Palissy ware.
Parian biscuit.
Paste.
Pâte changeante.
Pâte-sur-pâte.
Pernette.
Pipe.
Pipe press.
Plaque.
Plate machine.
Porcelain.
Porcelain colors.
Porcelain, electro-plating.
Porcelain kiln.
Porcelain molding.
Porcelain muffle.
Porcelain pâte tendre.
Porcelain plate machine.
Porcelain stove.
Potter's wheel.
Pottery.
Pottery furnace.
Pottery mill.
Printing.
Pug mill.
Queensware.
Rafaëlle ware.
Re-pressing press.
Scroddled ware
Seggar.
Sèvres.
Sgraffito.
Slip.
Soft paste.
Sole tile.
Spur.
Staffordshire ware.
Stanniferous glaze.
Stilt.
Stone-ware.
Stone-ware kiln.
Tempering wheel.
Tender porcelain.
Terra cotta.
Terre-cuite.
Throwing wheel.
Tile.
Tile machine.
Tortoise-shell ware.
Transfer printing.
Under-glaze.
Wedgewood.
White brick.

See also list on page 1779, "*Mech. Dict.*"

Fig. 584.



Excavating and Deodorizing Apparatus.

Ceph'a-lo-trite. (*Surgical.*) An instrument for crushing the fetal skull in obstructed labor.

Lusk's cephalotrite is shown at Fig. 1219, p. 516, "*Mech. Dict.*"; Braun's and Simpson's are shown at Figs. 534, 534 *b*, Part III., "*Tiemann's* "*Armamentarium Chirurgicum.*"

The *Craniotomy forceps* (*Meigs* and *Thomas*), and *Simpson's Cranioclast*, are crushing instruments of a more distinctly forceps-shape.

Ce-ram'ic Kiln. One for baking, burning, and firing pottery. The term *baking* is applied to the comparatively moderate heating of green ware to bring it to the biscuit condition. *Firing* and *burning* are optional terms, referring to the final heating where the glaze is melted and the colors vitrified. See various terms in list on page 186.

See Porcelain Kiln, Pottery Kilns, etc., "*Mech. Dict.*"

Also Report by Gen. *Q. A. Gillmore*, "*Centennial Exhibition Reports*," vol. iii., Group II., p. 222 *et seq.*

Including the kilns of —

Morand	* p. 222.
Gregg	* p. 225.
Menheim (Gas)	* p. 229.

See also Brick Kiln, *supra.*

Cer'a-tome. (*Surgical.*) A knife to divide the iris. *Keratome.*

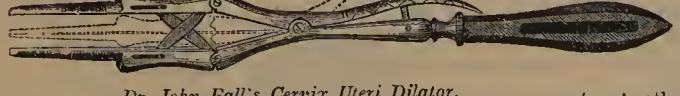
Cer'e-sin. A mineral or fossil wax, the purified product of *ozocerite*, found near the extensive coal-beds of lower Germany and Austria. A substitute for beeswax.

Amber, kauri, ozocerite, are fossil gums.

See list of gum resins and gums, p. 1921, "*Mech. Dict.*," and list of fossil resins, etc., p. 51, *supra.*

Cer'vix U'te-ri Di-la'tor. (*Surgical.*) The

Fig. 583.



Dr. John Ball's Cervix Uteri Dilator.

internal os is expanded by the instrument, which is introduced while closed, and then expanded with parallel jaws by pressure upon the lever.

Dr. *Hauk's* dilator is of hard rubber.

Dr. *Sussdorff's* of tupelo wood; a species of *Nyssa*, growing in Florida.

Cer'vix U'te-ri Scis'sors. (*Surgical.*) Bent scissors, smooth or tooth-edged, for amputation of the cervix.

Figs. on p. 81, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cess'pool Pump. An apparatus for emptying cesspools by means of pump, hose, and wheeled reservoir. Fig. 584.

A 600-gallon tank is mounted on wheels, and has inlet and outlet valves. A 4″ smooth-bore rubber hose, with imbedded spiral to prevent collapse, is used in lengths of 15′ for suction and discharge, having the usual couplings. The air in the tank, as displaced, is driven through a deodorizing can shown in front of the tank, on the rear of which is an indicator. A force-pump connects by suction hose with the vault, and by force hose with the tank. A peculiar flexible rubber tube forms the valve.

Cess'pool Trap. A water joint made at the entrance to a cesspool or pipe leading thereto, to prevent reflex current of fetid gas. See Sewer Trap.

C. G. S. (*Electricity.*) (Centimeter-gramme-second.) An abbreviated expression for one *dyne.* — *Gordon.*

Cha'fing Plate. A metallic plate interposed between two objects to take the wear. Instances are to be found in the *transom chafing-plate* and the *truck-bolster chafing-plate* of a car truck.

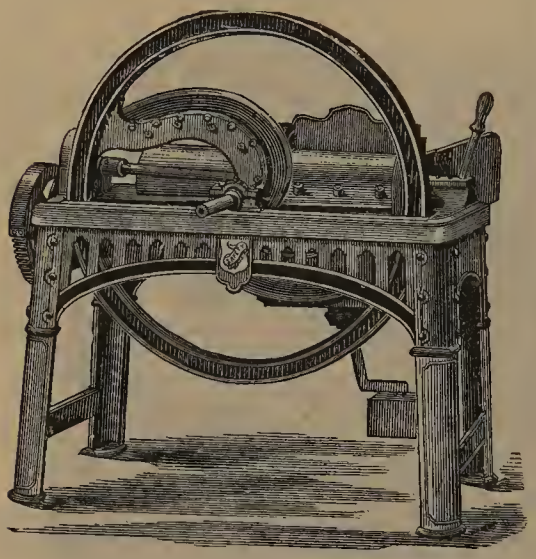
Chaff Sift'er. A machine used to separate seeds and dust from the chaff which comes from the thresher.

Chaff Cut'ter. The machine, with the Edwards (Br.) improvement, for preventing accident, is perhaps the safest machine extant. One can stop the machine, change the direction of feed, or change the length of cut, by a single lever. This is shown at the right of the machine, and is convenient to the left hand of the person who might find his right hand about to be nipped by the rollers. Fig. 585.

Another machine places the shifting lever in such position that a simple pressure even of the body in leaning against it, will stop and reverse the machine.

In another British machine, the same handle which alters the length of cut also acts as a stop-motion, instantaneously arresting the progress of the rollers. Should any hard substance get into the feed when working by power, the attendant moves the handle, which at once stops the rollers and

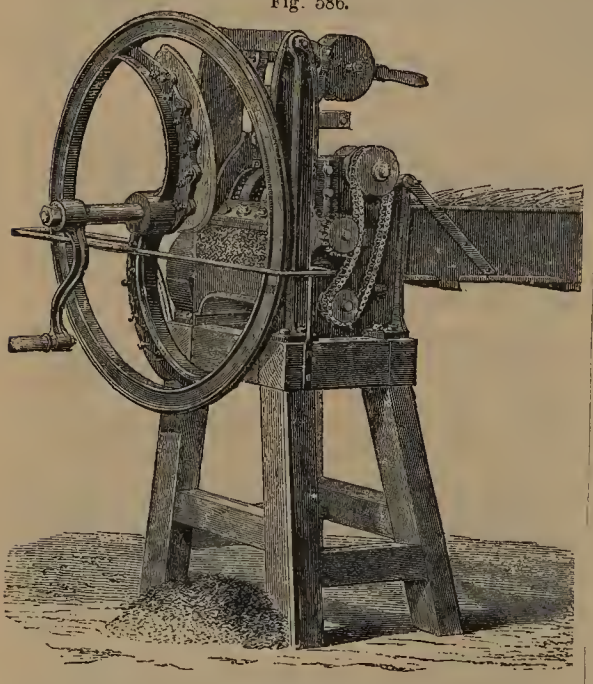
Fig. 585.



Edwards's Chaff Cutter.

throws back the feed about ¾″ from the knives, so that the hard substance cannot be struck again. To draw the feed quite back into the hopper the attendant has only to pull round the wheel at the end of the machine, which can be done while the fly-wheel is running at full speed.

Fig. 586.



Albaret's Chaff Cutter (French).

Albaret's Chaff Cutter (French), Fig. 586, shows the favorite French feed motion, by chain. The knives have the same disposition as the British, the best principle as it appears to the writer, that is, a curved knife (or knives) revolving in a plane across the direction of feed. See ENSILAGE CUTTER.

Chain. See the following references: —

Belt	* "*Scientific American Sup.*," 89.
Brake, railway automatic, *Park & Webb*, Br.	* "*Engineering*," xxx. 73.
L. & N. W. Railway, Br.	* "*Engineer*," xxv. 46, 104.
Making, hand	* '*Sc. American Sup.*," 677.
Coupling, *Vidal*, Br.	* "*Engineering*," xlix. 190.
Pump, *Wallis*	* "*Scientific Am.*," xxxviii. 393
Testing machine, *Richte*	* "*Am. Manuf.*," Jan. 17, 1879, p. 13.

See also CABLE TESTER, *supra*.

Chain Bit. (*Manége.*) One having a chain mouth-piece.

Chain Hook. (*Add.*) 3. (*Surgical.*) A chain with claw-hooks at the ends, used in post-mortems and dissecting to keep parts distended.

Figs. 317, 319, Part I., *Tiemann's "Armamentarium Chirurgicum."*

Chain Tag. A steam vessel which moves by winding on a chain laid in the bed of the stream.

Probably derived from *taglia*, It., a pulley; a word adopted into English and recognized by Brande; now but little used. See TOWAGE, p. 2605, "*Mech. Dict.*" CHAIN TOWING, p. 521, *Ibid.*

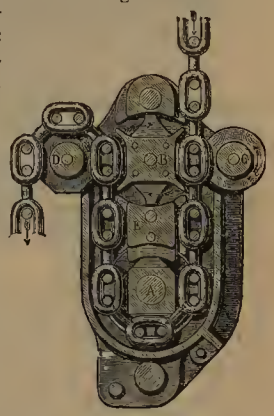
Fig. 587.

Chain Bucket.

Chain Buck'et. The valve on the chain of a pump. It is elastic, fills the pipe in ascending, and lifts and discharges the water. See CHAIN PUMP.

Chain-Ca'ble Shear. A heavy shear with jaws specially fitted for cutting iron for links of chain cables. The knife is made stepped, so as to cut only on one side of the cable at once, which reduces the diameter of the cylinders. Tweddell's hydraulic chain-cable shear is made double, to suit cables varying from 3″ to 1¾″ diameter. The water works under a pressure of 1,500 pounds per square inch in the cylinder.

Fig. 588.



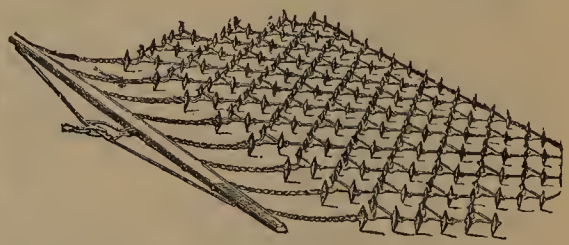
Chain Guide.

Chain Dog. A chain with a driving dog at each end, to be driven into adjacent logs in a raft to hold them together.

Chain Guide. A directing course for a lifting chain in a tackle-block of the differential class. See DIFFERENTIAL PULLEY-BLOCK.

Chain Har'row. A land harrow made of chain net-work, with teeth at the intersections.

Fig. 589.



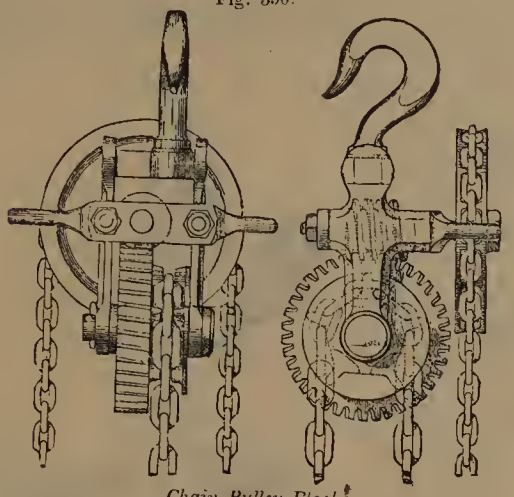
Chain Harrow.

Drawn over the ground, it laps upon and into all inequalities, and makes a very efficient implement in certain conditions of the ground.

Chain Hoist. A lifting tackle in which the power is communicated through the medium of a chain which runs over an indented wheel of the tackle. In Figs. 590, 591, the chain is continuous, and operates a wheel, on the shaft of which is a worm which gears into a cog-wheel on the shaft of the lifting pulley over which the hoist chain runs. When one hook of the latter is elevated the other is down, and the hoist chain is used back and forth alternately.

Chain Loom. A loom in which the harnesses are controlled by patterns on a chain; as distinguished from those operated by cams, or by Jacquard.

Fig. 590.



Chain Pulley Blocks.

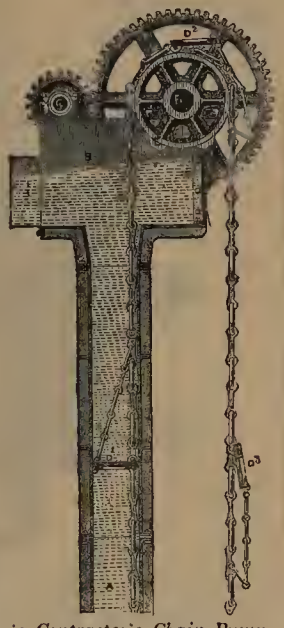
Chain Pump. In which the buckets are attached to a continuous chain. See Figs. 1228–1231, pp. 520–522, "*Mech. Dict.*"

Fig. 591.

Chain Hoist.

Murray's chain pump is specially adapted for hydraulic constructions, drainage, sewage works, etc., having no clacks nor valves proper to be obstructed by mud, sand, or weeds. The lift is pivoted and slung to the chain, and assumes its position in the up-shaft. If any obstruction enters, a hack turn of the chain immediatcly releases it, the lift folding up, and allowing the obstruction to be carried up in the stream.

Fig. 592.



Murray's Contractor's Chain Pump.

Fig. 593.

Chain Stopper.

Chain Stop'per. A tunnel with a pivoted flap to engage a link of chain to preveut the paying out of the latter.

Chain-tap'pet Loom. A loom for fancy weaving, in which the harnesses are operated by tappets upon a pattern-chain.

Chair. (*Add.*) 4. (*Glass.*) The bench of the glass-blower at which he sits, rolling the ponty to the end of which the glass under treatment is attached. Fig. 2243, p. 980, "*Mech. Dict.*"

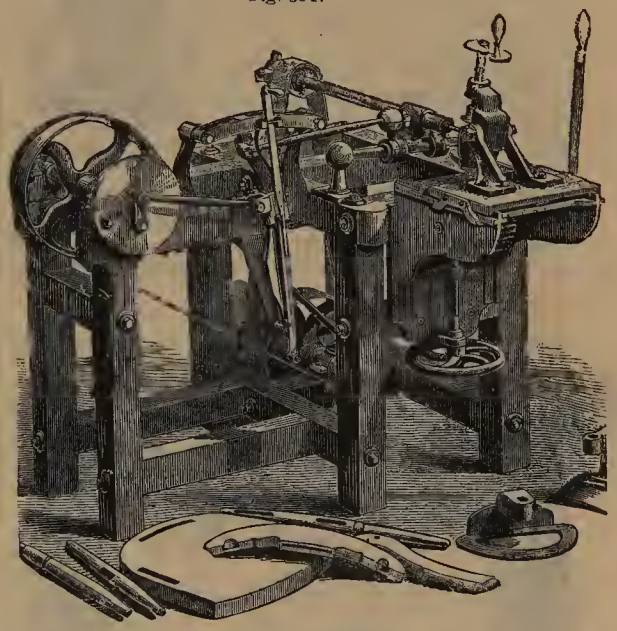
While thus being rotated, rolling by the left hand, the right has the *pucellas*, *shears*, *battle-dore*, to shape or trim: and the swinging, rolling, reheating, blowing, and shaping by tools constitute the manipulations by which the workman, principally guided by his eye, gives the form desired to the plastic mass. *Compasses*, *calipers*, a *rule*, and a *marver* complete the equipment. The *cage*, and the *forked stick* for removing the articles, belong to the boy who runs with them to the annealing oven, technically known as the *leer*.

Chair Mor'tis-er. Fig. 594 is a machine adapted to all kinds of chair mortising, straight or round work; also as a horizontal boring and mitering machine.

The principle of the machine is rotary: the fixed end of the boring bar moves in a ball-and-socket joint, allowing the bar to revolve and the vibrating end to be moved in any direction desired.

The variations from straight to mortises of different curves, are produced by the position of the curved bar, upon which the bearing of the movable end of the boring bar slides; when the bar is placed with the curve horizontal the mortises are straight, and changed to its greatest curve when perpendicular.

Fig. 594.



Lemman's Chair Mortiser.

The range in length of mortise is, from boring a hole to a length of mortise equal to the greatest travel of the cutting bit, and is changed by the stroke of the crank pin being made greater or less, and also by the arrangement of a handle moving the end of the connecting rod, to any position desired, upon a curved rod which produces a greater or less length of the connecting rods, giving any length of mortise desired within the capacity of the machine.

The depth of the mortise is regulated by moving the table, holding the stuff, by a lever in connection with a pinion and rack. The table is raised vertically, by a screw and hand wheel, and provided with three clamps, of different forms, for holding the stuff in the position required for the work.

Chair-stretch'er Lathe. A lathe with a hollow head; like a broom-handle lathe. It has four feeding rolls, two forward and two back of the hollow cutter, and heavy gearing with reversible feed.

Chal'lis. (*Fabric.*) A French worsted dress

goods woven upon a gauze or open taffeta loom. It has a silk *grège* warp, and merino-wool weft. It is generally printed. It differs from *barége* in the material of the warp, which in *barége* is of cotton.

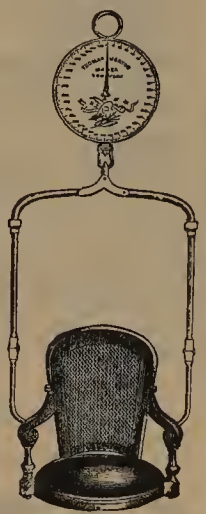
Cham'ber. (*Add.*) 10. (*Fire-arm and Ordnance.*) The space, enlarged or otherwise, occupied by the charge.

Cham'ber Kiln. A brick or tile kiln in compartments; sometimes capable of being heated in succession as with *Hoffman's*, Fig. 903, p. 371, "*Mech. Dict.*"

Johnson, Br. . . . . * "*Engineer*," xlix. 210.
See also BRICK KILN.

Chair Bal'ance. A chair suspended from a spring balance to weigh persons.

Fig. 595.



Chair Balance.

Cham'oied. (*Leather.*) Shamoyed. See TAWING, p. 2500, "*Mech. Dict.*"

Champ-le-ve'. (*Fine Art Metal Working.*) A species of enameling on metal.

Lines are engraved on the metallic surface and are filled with enamel. It is allied to *Niello*.

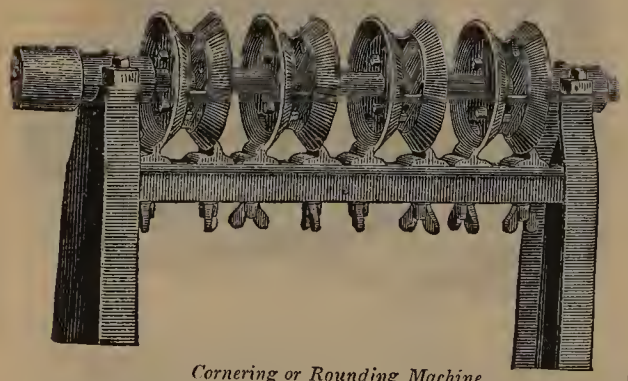
Differs essentially from *cloisonné*, which see. See also INLAYING.

Cham'fer-ing Ma-chine'. 1. A machine for beveling the ends of staves after being set in a cask. See BARREL-CHAMFERING MACHINE.

2. A machine for rounding or cornering timbers, preparatory to putting on the sand-belt; especially used in carriage and implement work.

In the cornering and rounding machine, Fig. 596, the several heads of the spindle are each provided with differently shaped cutters. The amount of corner to be taken off is governed by the dis-

Fig. 596.



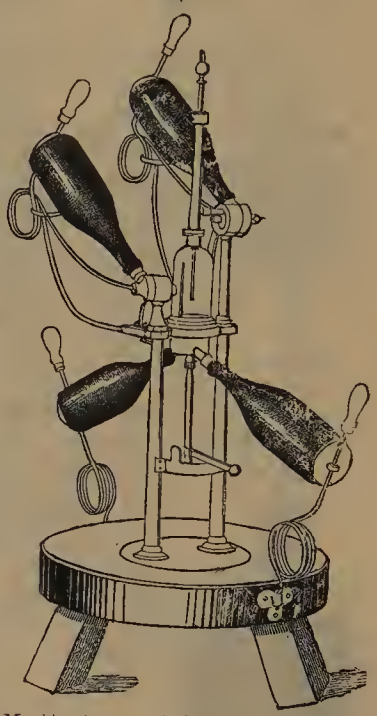
Cornering or Rounding Machine.

tance the bevel-guards are set apart, they being adjustable and retained in position by a set screw in the foot of each. A chamfer of any bevel may be made by having the guards of a bevel to correspond to it. Also known as a *radial planer*.

Cham'pagne Do'sing Ma-chine'. An apparatus for *dosing*, that is, adding to the wine a portion of sirup, which produces the sparkling ebullition peculiar to this class of wines. Fig. 597.

The bottle of champagne being uncorked, the mouth is placed against the cork-covered mouth of the spout, the bottom of the bottle being pressed by a spring-pad. The handle of the interior faucet is then turned and replaced, a jet of sirup being injected into the bottle. The faucet is of silver, moving on glass, and the pipes all of silver, polished inside, in order to prevent oxidation or lodgment of foreign matters. When the bottle is removed, it is ready for final corking and wiring.

Fig. 597.



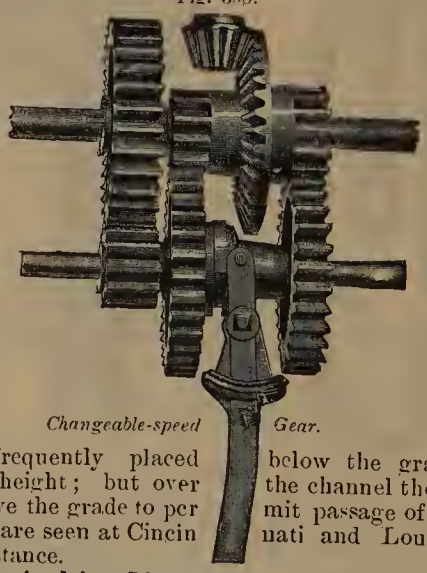
Machine à doser. Tricourt & Cie., Reims.

Change'a-ble-speed Gear. A nest of gearing placed between the motor and the driven object and so arranged that the speed of the latter can be varied at will by the motion of a lever.

The illustration, Fig. 598, is the changeable gear of the "Climax" mower. By moving the shifting lever to the left, the double clutch is thrown into gear with the slow or ordinary motion. By moving it to the right, this same clutch is thrown into gear with the fast motion. By moving this lever on to the pin in the center of the shifting lever-holder, the machine is thrown out of gear entirely.

Chan'nel Span. (*Bridge.*) In long truss bridges over shallow rivers, the trusses of the spans

Fig. 598.



Changeable-speed Gear.

are frequently placed below the grade, to save height; but over the channel the truss is above the grade to permit passage of boats. Such are seen at Cincinnati and Louisville, for instance.

Chan'nel-ing Machine'. A machine for making channels or grooves in stone in the quarry to make a line of separation.

Vermont Stone-cutter Co. . . * "*Engineering*," xxii 267.

Chap'let. (*Add.*) 2. (*Founding.*) A wrought iron stud for holding a core in position within the mold. Also called a *grain*.

Char'coal Grind'ing Mill. (*Gunpowder Making.*) Shown in "*Ordnance Report*," 1879, Appendix I., Plate I., Fig. 1, and description on pp. 98, 99. It is in the style of a bark mill, a conoidal grinder in a case of corresponding shape.

British . . . . . * "*Engineering*," xxv. 37.

Char'coal Pen'cil. The charcoal crayon of Heilmann is made from the saw-dust of willow, lime, or poplar, pressed in molds, dried in air, charred in a retort. The crayons are rubbed smooth, cased in paper, packed for sale. — "*Papier Zeitung.*"

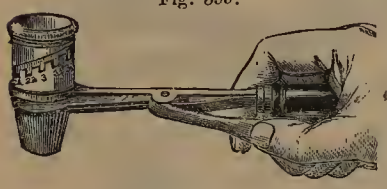
"*Scientific American*" . . . . . xxxviii. 326.

Char'coal Wash'er. A machine for washing bone-black for sirup filters. See ANIMAL CHARCOAL WASHER, *supra*, and BONE-BLACK CLEANING-APPARATUS, p. 327, "*Mech. Dict.*"

Kluseman . Dept. Agric., Sp. Report, xxviii., Plate XXIX.
Schrieber . . Dept. Agric., Sp. Report, xxviii., Plate XXX.

Char'ger. An instrument for measuring powder and shot, and loading into a fowling-piece. One is shown at Fig. 1250, p. 528, "*Mech. Dict.*"

Fig. 599.

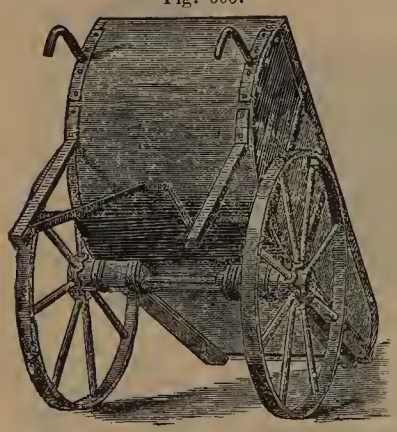


Dougall Charger.

Dougall's charger is a dipper, graduatable by slide for quantity, and discharging the contents into the gun by pressing the lever with the thumb.

Char'ging Bar'row. A double-wheel barrow, for use in iron furnaces for conveyance of coal, coke, limestone, and ore, to be dumped in at the tunnel-head of the blast furnace. It is made of a height in accordance with that of the curb of the furnace mouth, in order to insure the charge being properly dumped. See BELL AND HOPPER, p. 92.

Fig. 600.



Charging Barrow.

Cha'ser. (*Add.*) 3. A *billet.* A short strap on the curtain of a carriage, fastening to a buckle on the back-stay of the top.

Made raised and creased. See BILLET.

Cha'sing. 1. (*Fine Art Metal Working.*) A mode of ornamenting silver ware. It ordinarily follows the snarling tool used in *repoussé* work.

The vessel being filled with a resin composition is placed on a pad, and the surface indented by punches of various forms according to the pattern, and the texture of surface required. Fig. 1256, "*Mech. Dict.*" Fig. 11, p. 290, vol. xxxvi., "*Scientific American.*"

2. Thread cutting on a lathe, by slide rest tool or by comb. See Fig. 1256, above cited.

See also admirable collection of tools, "*Scientific American,*" * xl. 223.

Check Chain. (*Railway.*) A chain connecting the car body with its truck, and intended to keep the truck from swinging cross-wise of the track if the truck should become derailed.

Check Guard. A means of preventing tampering with bank checks, raising the figures, etc.

Check-testing apparatus, bank, *Grafelman.*
* "*Scientific American,*" xxxvii. 227.
Check protector, *Adair.* U. S. Patent, March 5, 1872, perforates amounts, both figures and words.

Check'ing. Engraved cross-hatching on certain parts of a rifle, gun or pistol stock, to increase the security of grip in handling.

Checking machines are used in armories for cross-hatching the swivel keys of rifles, etc.

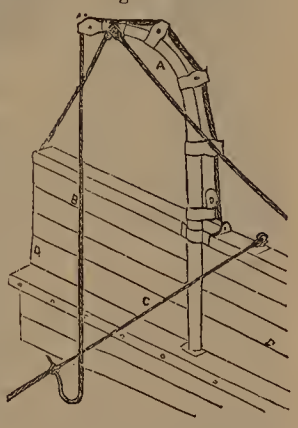
Check Row'er. 1. A corn planter.

2. An attachment to a corn planter by which it is made automatically to drop the seed corn at regular intervals of distance across a field; dispensing with the furrowing out of a field previous to crossing it with the planter, and dispensing also with the assistant at the dropping lever. Haworth.

See CORN PLANTER.

Check Stop. A device used in dredging. The light line *c* breaks when the dredge fills or is foul, brings the slack of the drag-rope *d* on the davit *A* into play, and gives time for the *check stop* — a drum of rubber — to come into play. See DREDGE; also ACCUMULATOR 3, p. 3, *supra.* See also DREDGE.

Fig. 601.



Check Stop for Dredge Lines.

Check Strap. (*Manége.*) *a.* The strap of a harness whereby the collar is connected between the fore-legs to the belly-band, to keep the collar from riding up when the horse is holding back in descending a hill or backing.

b. A strap which couples back the bit of the off-horse to the gears of the one on the near side, to hold back the off-horse when hitched on the *single-line method,* common in the West. A *hold-back* strap.

Check Valve. A valve to prevent reflux of a liquid.

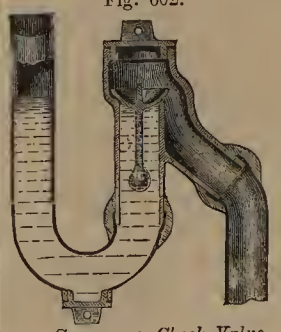
The most familiar instance is the valve below the plunger barrel of a pump, which prevents the return to the well of the water in the stock.

The most familiar distinction of check valves arises from

Shape.	Position.	Purpose.
Globe.	Upright.	Injector.
Disk.	Horizontal.	Pump.
Flap.	Angle.	Sewer gas.
Ball.	Oblique.	Trap.
Butterfly.	Swinging.	Brake.
Piston.		Alarm.
Cone.		Back pressure, etc.

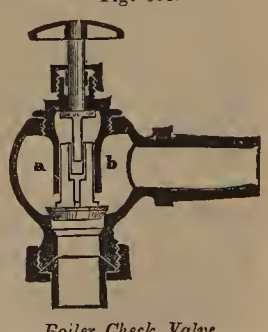
(*Railway.*) In the Westinghouse driving-wheel brake; a valve which is placed in the pipe which connects a driving-wheel brake-cylinder with the air-reservoir. The pressure in the reservoir causes the valve to seat itself or close. The air must then flow through a small hole which is drilled in the valve, which prevents the brakes from being applied too

Fig. 602.



Sewer-gas Check Valve.

Fig. 603.



Boiler Check Valve.

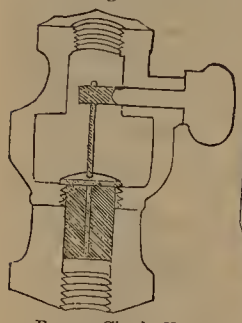
suddenly. When the brakes are released, this valve unseats, and permits a quick escape of the air. *Forney.*

Fig. 602 is *Waring's* check valve for sewer gas traps.

Fig. 603 is the boiler check valve of the injector apparatus of locomotives.

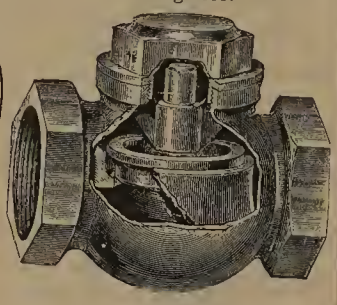
Fig. 604 is the lower check valve of the Douglas pump, placed in the suction pipe of the pump, at a convenient point to get at to let back the water to avoid freezing. Turning the thumb-screw lifts the valve, so that the water will run back.

Fig. 604.



Pump Check Valve.

Fig. 605.



Cushion-seated Check Valve.

Fig. 605 shows Shaw's cushion-seat check valve, designed to prevent hammering on the seat. A portion of the pumped liquid is confined in the annular space around the disk, which in falling seats itself upon a cushion of liquid.

Ball, *Hay & Bassett* . * "*Scientific American*," xxxvii. 182.
Swinging . . . . . * "*Manufacturer & Builder*," x. 220.

Check. (*Add.*) 13. (*Mining.*) The side or wall of a vein.

14. (*Manége.*) That portion of a bit outside of the horse's mouth.

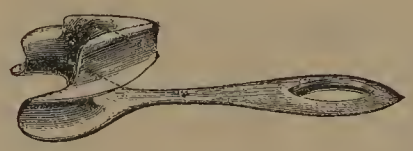
15. (*Nautical.*) Of a block; one of the pieces forming the sides of the shell. These have *scores* on the outside for the *strap*, and holes with *bushing* for the *pin*.

Cheek Re-tract'or. (*Surgical.*) A smooth flat hook to hold the cheek retracted and mouth distended when operating for cleft palate, *staphylorraphy*; or in grafting in cases of deficiency of the soft palate, *uraniscoplasty*.

See Figs. 298, 298 *b*, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Dr. Roe's mouth-gag and cheek retractor is a modification of the instrument of *Luer*, in respect of the addition of a

Fig. 606.



Roe's Cheek Retractor.

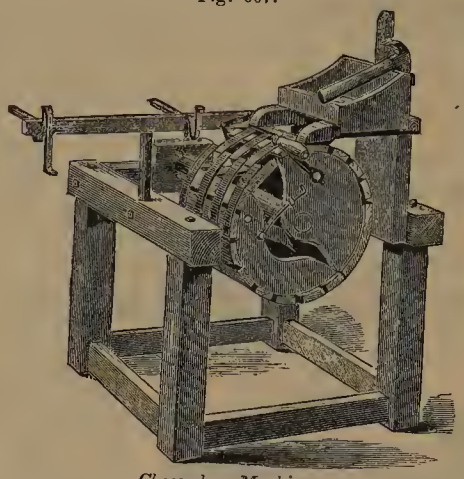
triangular or wedge-shaped block to the external surface of the cheek retracting portion of the instrument, this portion passing between the teeth and distending the jaws. A cord is passed through the hole in the handle and tied behind the head.

Cheese Box Ma-chine'. A bench used in making cheese boxes. A horizontal stem holds the former on which the box is to be built. The box is in fact a cage of slats and hoops which are put together on the former, the latter acting as a core for the frame during construction. Fig. 607.

Cheese Knife. A device for cutting a given weight of cheese in retailing. Fig. 608.

The cheese is weighed and placed on the platform, which is rotatable by the small crank at the side. By referring to the table on the column supporting the knife, there is found opposite the number representing the weight of the cheese the number of revolutions or fractional parts thereof the small crank has to be turned to measure off a pound. Then by turning the large crank, the knife blade descends, cutting off the required sector by a single stroke.

Fig. 607.



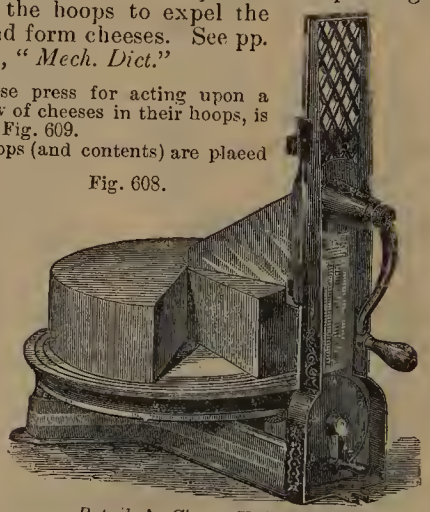
Cheese-box Machine.

Cheese Press. A press for squeezing the curd in the hoops to expel the whey and form cheeses. See pp. 533, 534, "*Mech. Dict.*"

A cheese press for acting upon a whole row of cheeses in their hoops, is shown in Fig. 609.

The hoops (and contents) are placed

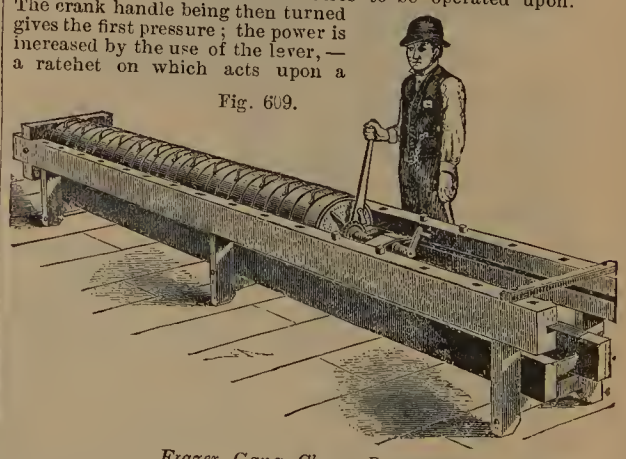
Fig. 608.



Retailer's Cheese Knife.

in a horizontal frame, and advanced by a screw. The screw device is adjustable on such part of the length of the frame as may suit the number of cheeses to be operated upon. The crank handle being then turned gives the first pressure; the power is increased by the use of the lever, — a ratchet on which acts upon a

Fig. 609.



Frazer Gang Cheese Press.

wheel upon the screw. A trough beneath receives the expressed whey.

Compound lever cheese press . * "*Sc. American Sup.*," 2468.

Chei'lo-an'gi-o-scope. An apparatus designed by *Dr. Huber*, of Greifswald, to enable the circulation of blood of a person to be examined.

The previous methods of ocular demonstration of the circulation have been, by placing the foot of a frog on the stage of the microscope, exhibiting the circulation in the

web. *Perkinje's* experiment, by which an observer is enabled to observe the circulation in his own retinal blood-vessels, is also familiar.

Dr. Huber fixes the head of the subject to be examined in a frame not unlike that used by photographers, on which is fixed a holder for the microscope and a lamp. He then draws down the lower lip of the subject upon the stage of the instrument, with its delicate inner surface upward for inspection, throws a strong light on the same with a condenser, and focuses the microscope, provided with a low-power objective, down upon the delicate net-work of blood-vessels, which can be seen there even with the naked eye. By this simple means the circulation can be observed with the greatest ease and perfection.

Chem'i-cal Fire En'gine. A fire extinguisher which depends upon the evolution of carbonic acid gas, alone or in company with water, for the extinction of fire. See FIRE ANNIHILATOR, "*Mech. Dict.*"

Che'not Steel. (*Metallurgy.*) A peculiar iron is carbonized with such matters as fat, resin, tar.

Chick'en Feed'er. See ÉPINETTE.

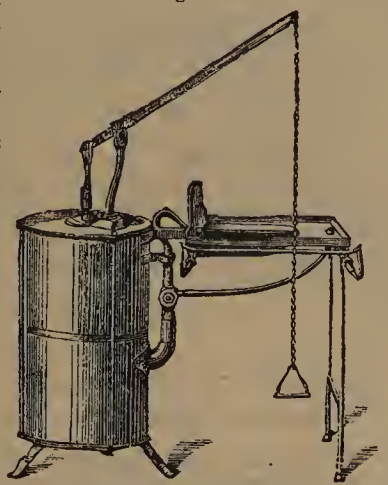
Chick'ley. A gum resembling gutta-percha, obtained from one of the *sapoteæ*, in Guiana.

Chif'ney Bit. (*Manége.*) A curb-bit having a movable short arm attached to the cheek-piece, just above the mouth-piece, for receiving the check-straps of the bridle, the gag-rein or strap being attached to the short arm of the cheek-piece.

Chill. 1. The hardened part of a casting: as the tread of a car-wheel.

2. A portion of a mold against which the molten metal is suddenly cooled in order to harden the casting.

Fig. 610.



Enfer's Chemist's Forge.

Chilled Plow. A plow the mold-board of which is cast on a chill to harden it and increase its wearing and polishing qualities.

Chilled Roll. See CALENDER ROLL.

Chem'ist's Forge. A laboratory forge. That shown in Fig. 610 is by *Enfer*, of Paris. It has a Chinese-lantern bellows in the cylinder, worked by a treadle and lever. It is primarily intended for lamp or gas blow-pipe, but has many convenient applications. Other forms are shown under LABORATORY FORGE, BLOWPIPE, etc.

Chime. 1. (*Music.*) A succession of bell sounds. Bells are usual; wires or bars are occasionally used. Evelyn mentions a chime of porcelain dishes.

Electric chime for clocks . .	"*Sc. Amer. Sup.*," * ii. 702.
Chiming clock, Bombay Univ.	"*Sc. Amer. Sup.*," * iii. 946.
Centennial chime	"*Iron Age*," xvii., June 29, 3.
French carillon	"*Sc. Amer. Sup.*," * 2093.
Carillon	"*Manuf. and Builder*," x. 252

See also CARILLON.

2. (*Casks.*) See CHINE.

Chim'ing Ma-chine'. The chiming machine consists of a drum studded with pins and turned by a crank, after the manner of a barrel-organ, whereby the ropes of the bells are pulled so as to produce particular tunes mechanically. See CARILLON.

Chim'ney. 1. A flue.

Climbing apparatus, Ger.	* "*Engineer*," xli. 23.
Exterior	* "*Scientific American Sup.*," 149.
Construction, *Bancroft* .	"*Scientific American Sup.*," 1841.
Climber	* "*Scientific American*," xlii. 386.
Glasgow (454 feet) . .	"*Van Nostrand's Mag.*," xvi. 91.
Cowl, Engl.	* "*Scientific Amer.*," xxxv. 69.

See *Armstrong's "Chimneys for Furnace, Fire-places, and Steam-boilers."*

2. (*Mining.*) Chimneys are the richer spots in lodes as distinguished from poorer ones.

Chi'na Grass. A fiber resembling the Rhea. It is prepared for manufacture by treating with a hot solution of carbonate of soda.

Chine. 1. The end of a stave at the head of a cask or tub.

2. The edge formed by the ends of the staves.

Chi'nese Pa'per. Commonly known as rice paper. This is prepared by the Chinese from the stems of a leguminous plant, *Aralia papyrifera;* these are cut so as to form a continuous spiral film, which is then pressed flat, and afterwards dyed or otherwise prepared. They also make a true paper from bamboo stems by pulping and forming into sheets.

The Egyptian papyrus was also a pith paper, but the description of its manufacture by Pliny does not convey (as translated) the right impression as to the mode. The stem is a triangular prism; the sides were pared off, and the slips thus obtained united by their edges while yet damp, by means of pressure.

The Japanese and Chinese make paper also from *Broussonetia papyrifera*. See p. 1606, "*Mech. Dict.*" This source yields also the *tapa* cloth of Hawaii, the *masi* of the Fijians. See "*Atlantic Monthly*," xxxi. 233.

Chin-chil'la. (*Add.*) (*Fabric.*) *b.* A camel's hair French goods.

Chintz. (*Fabric.*) From Hindu, *chint* or *chete*, "variegated" or "spotted," whence *cheta*, the hunting leopard.

Chip Syr'inge. A rubber bulb syringe used by dentists to wash away detritus from a tooth under treatment. See BULB SYRINGE.

Chip Break'er. 1. A plate on the back of a plane bit, to bend up the chip and prevent splitting of the board.

2. A clip or piece on the side cutter-head frame in a matching machine; breaking the chip prevents splitting of the edge of the board.

Chis'el. (*Surgical.*) An instrument driven by a mallet for cutting bone. The gouge is a chisel with a curved edge, and has a similar use. Used in *osteotomy*, post-mortems, and dissecting. Chisels are edge or end sharpened, and some have specific names.

The figures refer to *Tiemann's "Armamentarium Chirurgicum."*

Knife chisel	Fig. 86 *b*, Part I.
Chisel	Figs. 86, 331, Part I.
Gouger	Figs. 84, 84 *b*, 85, 86 *c*, Part I.
Rachitome	Fig. 321, Part I,
Costotome	Figs. 322, 333, Part I.

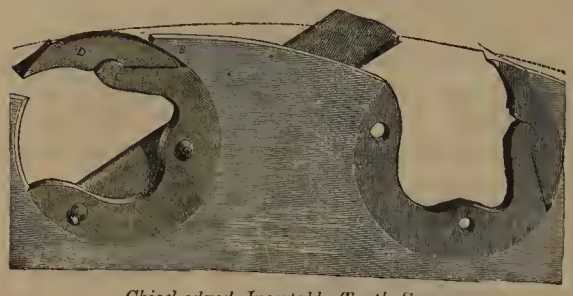
MacOwen's bone chisel is used in operations for bow-legs and knock-knees.

Chis'el Tooth Saw. A saw tooth which exposes a chisel edge to the wood in sawing, aiming rather to cut than to tear. Fig. 611 shows the Hoe insertable tooth saw, two only of the teeth of a circular saw being included in the cut. Behind the saw is the tool with two studs, by which the tooth is set in or removed from its socket by a movement of rotation.

See INSERTABLE TOOTH SAW, Fig. 4596, p. 2035, "*Mech. Dict.*"

Chlo'ride of Lime Bat'te-ry. (*Electricity.*) *Niaudet.* The positive electrode is a plate of zinc, and the negative a plate of coke, surrounded with

Fig. 611.



Chisel-edged Insertable Tooth Saw.

coke fragments. The zinc is in a solution of chloride of sodium, and the coke surrounded with chloride of lime in a vessel of biscuit ware or parchment paper.

Niaudet . "*Scientific American Sup.*," 3341, 3359, *3490.

Chlo'ride of Sil'ver Bat'te-ry. (*Electricity.*) Maric-Davy appears to have been the first to use chloride of silver in batteries. It has become more important since improved by De la Rue. A positive element of zinc and a negative element of chloride of silver are suspended in a solution of chloride.

"*Niaudet*," American translation . . . 201, *206.
"*Telegraphic Journal*" . . . . . *vi. 50.
Gaiffe "*Telegraphic Jour.*," . . . . . *vi. 398.
"*Scientific American Supplement*" . . *2490, *1829, 1922.
"*Jour. Soc. Tel. Engineers*" . . . . *vii. 54.

Chlo'ride of Tin Bat'te-ry. (*Electricity.*) Invention of Adolph Gutensohn. One in which a salt of tin, preferably the chloride, is used in the chamber containing the negative plate.

"*Scientific American Supplement*" . . . . 3791.

Chlo'ri-na'tion. (*Metallurgy.*) A solution process in extracting metals. See p. 542, "*Mech. Dict.*"

Copper process . "*Painter's Report, Vienna Exp.*," iv. 130.
Furnace, *O'Harra*, * "*Mining & Scientific Press*," xxxiv. 297.

Chlo'ro-form In-ha'ler. (*Surgical.*) An instrument for administering this anæsthetic. See INHALER, "*Mech. Dict.*"

Chock. (*Add.*) (*Nautical.*) 4. A block with recess and horn-shaped projections, between which a cable or hawser is rove when being hauled on or in.

Fig. 612.

Chock.

Chock Block. A scotch for the wheels of

Fig. 613.

Chock Block for Thresher.

machinery to be used without dismounting, such as threshing machines.

See "*Engineering*" . . . . . *xxii. 151.

Chop'ping Mill. A mill for coarse-grinding grain for stock. In France it is an *aplatisseur*, *concasseur*, or *broyeur*. In England a *kibbling mill*, grinding mill, etc.

Chop Sep'a-ra'tor. (*Milling.*) A machine for treating the meal coming from the roller mill, to separate the flour from the cracked grain.

Lampert . . . . . *"*American Miller*," vii. 385.

Chro'ma-trope. A device in a stereopticon to illustrate color effects; kaleidoscopic patterns, etc.

Morton . . *"*Scientific American*," xxxiv. 5; xxxiii. 344.

Chrome Leath'er. Hides tanned by means of chrome. Invented and patented by Dr. Heinzerling, in Germany.

"*Chemical Review*," Eng. . "*Scientific Amer. Sup.*," 4057.

Chro'mic Ac'id Bat'te-ry. (*Electricity.*) One in which a solution of bichromate of potassium takes the place of nitric acid in the Bunsen battery.

Scientific American Supplement" . . . . *2525.

Chro'mo-graph. An apparatus for reproducing maps, plans, etc. It consists of a shallow zinc box containing a white gelatinous composition. The writing is made with a special ink, laid face downward on the composition, and the hand passed lightly over it; about one minute is required to secure a transfer. A number of copies, from 10 to 40, may be obtained, according to the condition of the ink and the composition, by laying the sheets successively upon the transfer and lightly pressing by the hand. The writing may be washed off the composition. Also known as HECTOGRAPH, and by many other names.

Chrome Steel. An alloy of iron and chrome. It is made by melting in a crucible of refractory material a mixture of Bessemer or Siemens-Martin steel, and of pig or refined iron with an addition of chrome iron and of calcined and ground limestone. — *Kern.*

"*Iron Age*," xvii., June 8, p. 11.
"*Iron Age*," xvii., Aug. 17, 1876.
Chromeisen . . . . "*Scientific American Sup.*," ii. 692.

See also Baur's U. S. Patents, Nos. 47,510, 49,495, 99,624, 123,445.
See also CHROME STEEL, p. 2366, "*Mech. Dict.*"

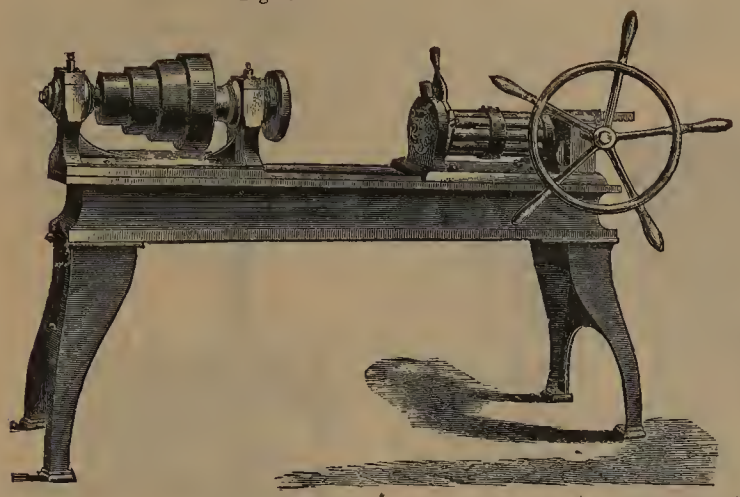
Chro'mo-li-thog'ra-phy. Picture making by successive impressions in various colors from stones. See pp. 545, 546, "*Mech. Dict.*"

History and Technics, "*Silcox's Vienna Exh. Rep.*," 1873.

Chro-mom'e-ter. An instrument designed by Professor Koenig for making delicate determinations of the amount of metals in ores. It is based upon the optical fact that complementary colors extinguish each other if mingled in proper proportions. Professor Koenig has applied this principle to the colors which certain metals — as iron, manganese, copper, etc., — produce when fused with borax.

He prepares glasses or beads containing known quantities of a metal in one hundred parts, and observes how thick a glass of the complementary color must be to produce extinction. To accomplish this the instrument is furnished with a glass wedge of a green or red color, cut at a very acute angle. By moving this wedge before the glass bead, with the help of a suitable rack movement, a scale moves at the same time, and when the point of extinction of color is arrived at, the reading of the scale refers to a table showing the percentage of metal contained in the examined substance. By this method of analysis a correct determination of manganese in an iron ore can be made in 15 minutes, or a copper estimation in 30 minutes.

Fig. 614.



Chucking Machine.

Chro'mo-pho-tog'ra-phy. Photographing in colors.

Processes . . . . . "*Scientific American Sup.*," 2079.
"*Scientific American*," xli. 260.
"*Scientific American*," xlii. 33.

Chro'mo-strob'o-scope. An instrument invented by Prof. A. Ricco, with colored glass and various designs. It is one of a class of scientific toys depending for its effects upon the persistence of visual impressions.

* "*English Mechanic*," xxiii. 168.
Ricco . . . . . * "*Scientific American*," xxxiv. 212.

See ANORTHOSCOPE, STROBOSCOPE,
CHROMATROPE, THAUMATROPE,
PHENAKISTOSCOPE, ZOETROPE,

in "*Mech. Dict.*"

Chron'o-graph. The British test of powder is by the velocity of the projectile, a given quantity with a service projectile from a proof-service gun.

The Boulengé chronograph is used. The first target is 45′ from the gun, the second 165′. The pressure in the bore is determined by the crusher-gage, — a modification of Rodman's pressure piston. See INTERNAL PRESSURE-GAGE, CUTTER, DYNAMOMETER, PIEZOMETER.

The Boulengé chronograph used at the arsenal of Spandau, Prussia, is shown at Fig. 36, Appendix L., "*Ordnance Report*," 1877, and p. 533.

See *Laboulaye's* "*Dictionnaire des Arts*," etc., tome iv., article "*Instruments d'Optique*," ed. 1877.

"*Scientific American Supplement*," 417.

See also ELECTRIC CHRONOGRAPHS AND CHRONOSCOPES.

Chron'o-scope. An instrument for measuring small intervals of time.

The following electro-chronoscopes are described by Dr. Barnard in his Report on the Paris Exposition of 1867 : —

Prof. Wheatstone. Col. Benton.
Prof. Henry. Capt. Martin de Brettes.
Capt. F. P. E. Schultz. Prof. Bashford.
Capt. Navez.

Dr. C. W. Tiemens . . "*Scientific American*," xxxv. 328.

See also ELECTRIC CHRONOGRAPHS AND CHRONOSCOPES.

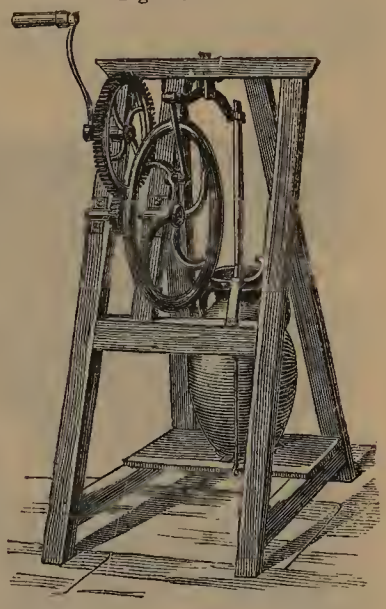
Chro'no-ther-mom'e-ter. An instrument, the invention of Mr. R. P. Wilson and used in the testing room of the petroleum association of London. The design is to raise the temperature of the oil at the rate of 20° in 15 minutes.

The invention consists of a watch movement in conjunction with a circular thermometer. The watch is provided with but one hand, and the balance-wheel is so adjusted that this hand moves through 20° of the thermometer scale in 15 minutes. It is, therefore, merely necessary, in making an experiment, to set the hand when the mercury reaches 80°, and to regulate the lamp so that the quicksilver and the watch-hand travel round the dial *pari passu*. If the thermometer is observed to be getting ahead of the watch, the light under the water-bath is slightly lowered (this being easily effected by the mechanical arrangement in the wick-holder), and, of course, *vice versa*.

The inner line of degrees marked on the thermometer scale represents minutes (1 to 15), and the outer line, degrees of Fahrenheit's scale, 20 of which (80 to 100), it will be observed, are equivalent to the 15 minutes, though, of course, in the construction of the instrument, any other desired rate of heating may be provided for.

"*English Mechanic*" . . . . . *
"*Scientific American Supplement*" . . . . * 181.

Fig. 615.



Breton Churn.

Chry'soid. A name given by Farmer to his alloys of aluminum which resemble gold and are adapted for watch-cases, chains, and jewelry.

Four series of formulas, —

Cu. Al. Ag.	Cu. Al. Fe.
Cu. Al. Zn.	Cu. Al. Ni.

are given with varying proportions, on p. 71 of "*Mech. Dict.*"

Chuck'ing Ma-chine'. A form of machine lathe. Fig. 614 shows a revolving-head drilling or chucking machine with 8 spindles. Instead of a common tail-stock there is a revolving or rocking head, revolving in a vertical plane, with several spindles, for facing, drilling, reaming, and counterboring small work.

By this means a piece may have several operations performed upon it without being removed from the chuck or face-plate. The several tools are brought forward as desired or in turn by the hand-wheel.

Churn. The Breton churn is shown in Fig. 615. The cream jar is clamped upon its stand and the dasher reciprocated vertically and rapidly by hand crank and gearing.

Churn Drill. A form of drill, the earliest type of which is in one of the forms of implements for obtaining fire by friction of one piece of wood on another.

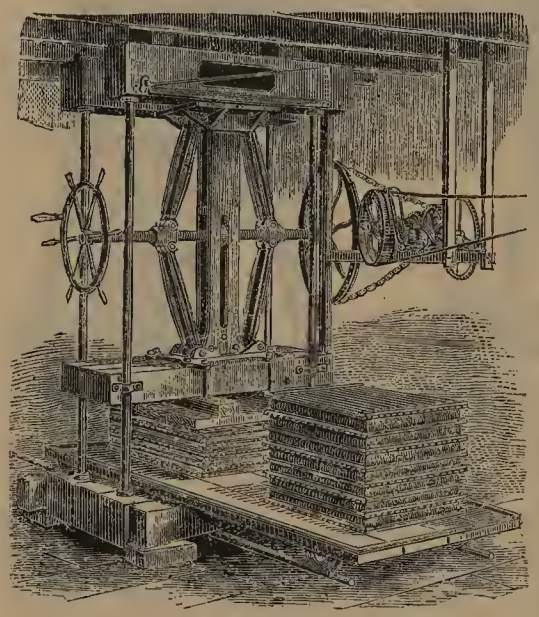
For an improved form see HAND DRILL.

Ci'der Press. The Boomer & Boschert cider press, Fig. 616, has a special grinder with an iron cylinder furnished with 8 steel knives placed in planed grooves across the face of the cylinder and held in place by iron bands at each end. Five concaves of flat steel springs are adjustable to any required distance from the cylinder, and each regulated to any degree of stiffness, but giving way to any foreign matter, such as stones.

The power press has a double platform which runs on rollers so that one cheese may be building while another is pressing.

In running down the press the right-and-left screw is rotated approaching the knees of the pair of toggles, passing through nuts in the knees, and rotated by the hand wheel at first but by means of the pulley, gearing, and chain as the work proceeds and more power is required. The movement

Fig. 616.



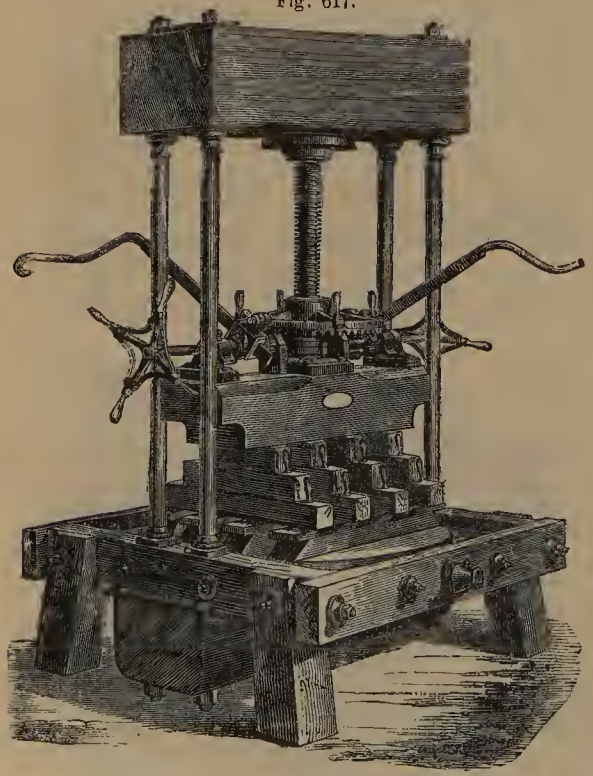
Power Cider Press.

becomes relatively slower as the toggles straighten, and the power inereased in a like proportion.

The follower is permanently attached to the end of the toggle arms so that it does not require placing and replacing.

The cheese eonsists of regular successive layers of pomace, each about 4″ thick, completely enveloped in cloth, each being shaped in a square frame which is raised, leaving the

Fig. 617.



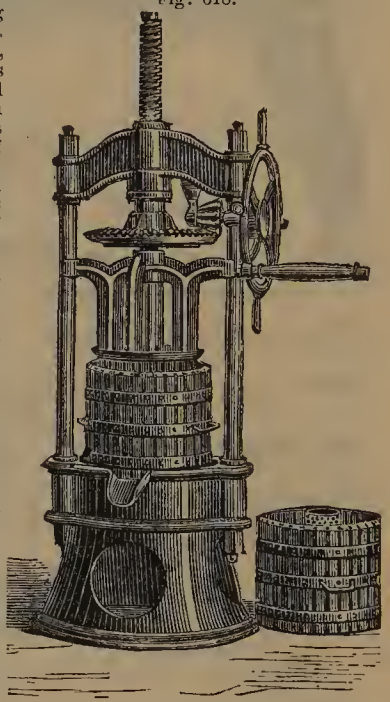
Press of David of Orleans.

same in position. Racks of wooden strips are laid between each layer of pomace.

The press, Fig. 617, made by David of Orleans, is one of the screw-presses of a type so common in France. Its general features will be readily understood from the illustration. The nut is revolved upon the screw and pushes down the follower or upper member of the press. What is notable is the eompact mode of obtaining the three powers. Quick motion and relatively small power at the first, the motion decreasing in rate and inereasing in power at eaeh subsequent stage.

The first motion is by the central wheel, which has handles projecting upward. The next power is by the hand wheels at the ends, pinions on the wheels engaging the crown wheel. Third and lastly, the brake levers which act by pawl and ratchet upon the pinion shafts in the manner of windlass brakes.

Fig. 618.



Wine & Cider Hand Press. (Nains, Terrel del Chênes.)

The cider and wine hand-press made by Nains, of Terrel des Chênes, is shown iu Fig. 618. It has an exterior and interior crate, so that the pomace is in a comparatively thin body, rendering the escape of the juice more ready and complete It may be said to have two powers; that is, in the first stage the master wheel is rotated by the erank arm, and subsequently by swinging the weight upon the spokes. The follower, it will be seen, is guided upon the standards and deseends in the annular spaee between the crates.

See also Wine Press; Oil Press; Olive Press.

Mill, portable, *Sikes* . * "*Scientific American*," xxxviii. 86.
Press, toggle motion.
Boomer & Boschert . * "*Scientific American*," xlii. 242.

Ci-gar′-box Tel′e-graph. Named from the compactness and portability of the instrument.

"*Scientific American*" . . . . . xxxvi. 20.

Cig′a-rette′ Ma-chine′.

French eigarette maehine, * "*Scientific Amer.*," xxxviii. 344.

Cil′i-a For′ceps. (*Surgical.*) Tweezers for removing the eyclashes. A species of depilating forceps.

Figs. 7, 9, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cin′der Notch. (*Metallurgy.*) A notch on the top of the dam of a blast furnace, to allow the slag to run off.

Cin′der Wool. A fibrous glass obtained by the action of a jet of air or steam upon molten slag as it issues from the blast furnace. See Slag, 10; Mineral Wool.

Cin′na-bar. (*Mining.*) Sulphuret of mercury.

Ci′pher-wri-ting Frame. A writing frame, paneled or otherwise, arranged for writing secret messages on a preconcerted plan.

Berghold . . . * "*Scientific American*," xxxvi. 406.

Cir-cas′sienne. (*Fabric.*) A French dress goods woven on a taffeta loom; it has a silk grège warp, and a mohair or silk-and-mohair warp.

Llanov has a cotton warp.

Cir′cle. A *traverse-circle*. An arc-shaped track on the terre-plein or gun platform, on which the

wheels beneath the chassis of a gun traverse as the gun is horizontally adjusted. Two such circles are shown beneath the Krupp gun-carriage, Plate VIII., p. 448, "*Mech. Dict.*"

In British practice known as *racers.*

Cir'cle Cut'ter. An optician's tool with a diamond on the arm, for cutting circles in thin glass for covers for objects on slides.

Fig. 619.

Circle Cutter.

Cir'cuit. (*Electricity.*) The path along which the current travels.

Cir'cuit Break'er. (*Electricity.*) A device by which the circuit is closed or opened at pleasure, or automatically. See TELEGRAPH KEY.

Cir'cuit Clo'ser. A key, for instance, for making a contact to complete a circuit. The *breaker* and *closer* are usually one, the alternate motions of the key closing and opening the circuit. See TELEGRAPH KEY.

Streidinger & Doerflin	.	* "*Engineer*," xliii. 153.
For torpedoes, *Abel*, Br.	.	* "*Engineering*," xxi. 96.
Mathieson, Br.	. . . .	* "*Engineering*," xxi. 96, 224.
McEvoy, Br.	. . . .	* "*Engineering*," xxi. 96.
For torpedoes, *Livermore*	.	"*Engineering*," xxi. 404.

Cir'cu-lar Bal'ance. A spring balance having a pointer which traverses a graduated and numbered dial.

Cir'cu-lar Com'pass. An instrument invented by *M. Duchemin*, in which an annular piece of metal is substituted for the needle. The annulus has its N. and S. poles at opposite points of the same diameter. The advantages claimed are greater sensibility and less disturbance from the vessel's motion.

Cir'cu-lar Knit'ting Ma-chine'. One with a circular race, making a tubular knitted fabric See Figs. 2769, 2771, pp. 1236, 1237, "*Mech. Dict.*"

Cir'cu-lar Loom. One for weaving tubes, hose, etc.

United States Patents in circular looms.

No.	Inventor.	No.	Inventor.
16,248	Nelson.	51,040	Greenough.
17,353	Carney.	52,718	Hull.
26,585	Grunwald.	53,372	Danby.
32,461	Bonard.	59,138	Slayton *et al.*
39,197	Darker.	72,362	Buser.
41,466	Slayton.	81,438	Wagner.
43,937	Veerkamp *et al.*	91,305	Brooks.
44,902	Walton *et al.*	98,738	Bryant.
45,208	Slayton.	*124,288	Reed.
45,629	Palmer.		

* Reissued.

Cir'cu-lar Plane. A plane with a flexible steel face, capable of adjustment to the arc required, within specific limits.

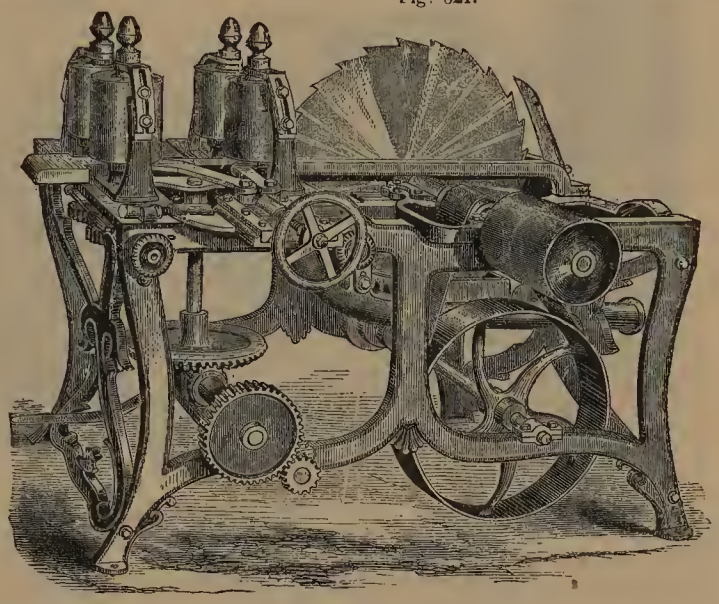
Fig. 620.

"*Victor*" *Circular Plane.*

Cir'cu-lar Re-saw'ing Ma-chine'. A machine for making bevel-siding and weather-boarding from thicker stuff.

The lumber is fed to the saw by four rollers, which are expansively geared in pairs, so that at whatever point they may be placed, the gearing

Fig. 621.



Circular Re-sawing Machine.

has the same effective feeding force. The rollers are hung upon ball-and-socket joints, which gives them an adjustment for bevel-sawing, and presents the center of the stuff to the saw, however the thickness may vary. The saw arbor has a lock attachment to keep it from moving while the saw is being sharpened or replaced. There are three speeds of feed to accommodate different widths of lumber.

Cir'cu-lar Rib'bing Ma-chine'. A knitting machine having a circular race, and adapted for rib-work, such as Cardigan jackets and sleeves.

The machines of *Gimson & Coltman*, of Leicester, England, are described in G. W Gregory's report on knitting machines, Group XXII., "*Centennial Exhibition Reports.*"

Cir'cu-lar Saw. (*Add.*) 2. (*Surgical.*) A round saw used in osteotomy in deep-seated parts. A substitute for *Hey's* saw.

Græfe's	Fig. 66, Part I.
Tiemann's	Fig. 57, Part I.

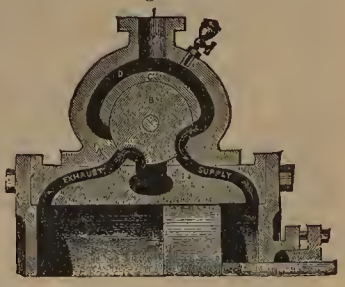
Tiemann's "*Armamentarium Chirurgicum.*"

Cir'cu-lar Spring Bal'ance. See CIRCULAR BALANCE.

Cir'cu-lar Slide Valve. A species of faucet valve. A cylindrical valve with ports made by depressions in its periphery, bringing the respective ends of the cylinder in alternate connection with the steam chest and exhaust port.

The term is not a peculiarly happy one, and will apply as well to the valves of the Corliss and Wheelock engines. See CUT OFF.

Fig. 622.



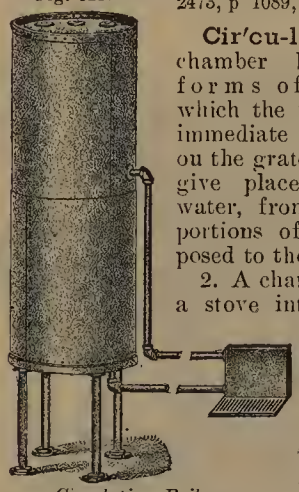
Circular Slide Valve.

Cir'cu-la'ting Boil'er. A boiler in connection with a heater, through which latter the water circulates to become heated.

Fig. 623 shows a heater for a domestic range, connected by circulating pipes with the boiler.

A circulating boiler, one of the very earliest of its class, is shown under INCUBATOR, "*Mech. Dict.*," which see. The invention of *Bonnemain*, 1777.

Fig. 623.



Circulating Boiler.

See system of steam-heating, Fig. 2473, p 1089, "*Mech. Dict.*"

Cir'cu-la'ting Drum. 1. A chamber belonging to some forms of steam-boilers, into which the water, heated by the immediate proximity of the fire on the grate, is caused to flow to give place to other bodies of water, from the feed, or from portions of the boiler less exposed to the urgency of the fire.

2. A chamber above or around a stove into which the heated gases pass in order to radiate heat.

3. A water-chamber in a hot-water heater into which passes the hot water from the coil exposed to the fire.

Cir'cu-la'ting Pump. 1. One for supplying water for the condensers of engines. The speed should be in proportion to the temperature of the circulating water and the working conditions of the engine.

2. The air and circulating pump is specially adapted for marine condensing engines. It is a direct-acting pump, and the two pumps are driven from the same steam cylinder.

Cir'cu-la'ting Steam Boil'er. One consisting of two portions unequally exposed to the heat of the furnace, and with connecting pipes or passages by which the water rises from the over-heated and descends from the relatively colder, maintaining a circulation.

*Stead's . . . * "Scientific American,"* xxxviii. 243.

Other illustrations may be found in Plate LXI., opposite p. 2326, "*Mech. Dict.*"

Cir'cu-la'ting Tube. In a steam boiler; a tube leading from one part of a boiler to another to establish a circulation in a given direction, as from the hotter to the portions more removed from the direct contact with the furnace or flue plates.

There are numerous illustrations of this feature. See Plate LXI. and pp. 2327, 2328, "*Mech. Dict.*"

See also *Oke*, "*Engineering*," * xxii. 328.

See list under STEAM, "*Mech. Dict.*," *et infra.*

Cir'cum-cis'ion In'stru-ment. (*Surgical.*) An instrument for excising the projecting portion of the prepuce beyond the glans in cases of phimosis.

Phimosis instruments, Figs. 1-7, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Dr. Baruth's circumcision scissors have a guard finger upon one blade which acts to prevent the clinging of the prepuce to the other blade when the blades are parted.

The phimosis instrument of Dr. Levis is for the excision of the inner inelastic membrane of the prepuce, or a partial ablation of the preputial integument, instead of complete removal.

Cire Per-due'. Bronze casting in wax. A model in wax is inclosed in a plaster mold, the wax melted out and bronze poured in. Thus the wax is *perdue*, or wasted. The plaster being removed the bronze object appears. See JAPANESE BRONZES; also pp. 500 and 1462, "*Mech. Dict.*"

Cis'tern.

Filtering, *Moscucci*, Fr. . .	* "*Scientific Amer. Sup.*," 2305.
	"*Scientific Amer.*," xliii. 340.
Day	* "*Scientific Amer.*," xliii. 403.
Rain water	"*Scientific Amer. Sup.*," 2393.
Filter	"*Scientific Amer. Sup.*," 1748.

Clam'mer. A forceps closed by a weight, used as a tongs in deep-sea soundings to obtain specimens of the bottom, shells, or of living occupants thereof.

Clam'ond Bat'te-ry. A thermo-electric battery. See p. 2545, "*Mech. Dict.*"

An improved form consists of an alloy of two parts of antimony and one of zinc as the negative metal, and ordinary tinned sheet iron as the positive element — the current at the heated junction flowing from the iron to the alloy. This alloy is cast in the form of a flat bar, broader in the middle than at the ends, and measuring from 2″ to 2¾″ in length by ⅜″ to 1″ in thickness. The sheet iron, properly stamped out, is placed in a mold into which the melted alloy is poured; before the alloy has cooled, the mold is opened and the bars are removed. This alloy melts at 500° Fah., and expands considerably on cooling. It improves on recasting, but is always very brittle. The bars are arranged radially around a temporary brass cylinder, a thin slip of mica being inserted between the iron and the alloy to prevent contact except at the point of junction. Eight or ten of these bars form a ring, and the several rings are placed one above another, insulated from each other by a circle of asbestos. The inner ends of the bars are heated by a Bunsen burner, the flame issuing in small jets in the annular space between the burner and the bars.

See also THERMO-ELECTRIC BATTERY.

Clamp. (*Add.*) 8. (*Surgical.*) A jawed holder, to maintain parts in apposition, to prevent circulation on a line of excision, etc.

Harelip clamp	Figs. 252, 253, Part II.
Nasal clamp (*Epistaxis*) . .	Fig. 239 *c*. Part II.
Ovariotomy clamp . . .	Figs. 439-444, Part III.
Pile	Fig. 579, Part III.
Scrotal	Figs. 175, 176, Part III.

Tiemann's "Armamentarium Chirurgicum."

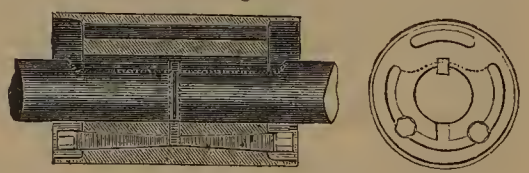
9. (*Boat.*) An iron brace to hold the boat's mast.

10. (*Leather.*) A wooden bench-screw, carrying two cheeks, used to prevent the leather from moving during the operation of stoning or slicking.

11. A stirrup-shaped metallic piece and binding screw to hold one of the elements of a battery and make the electric connection. See CARBON CLAMP.

Clamp Coup'ling. A means of uniting the adjacent ends of two shafts in a thimble. The

Fig. 624.

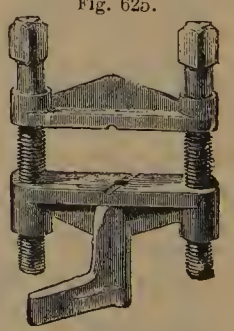


Clamp Coupling.

coupling is formed from one casting, combining the inner clasps with the outer casing, between which are inserted lengthwise fine thread taper screws. The clamps are divided across the center of the coupling, and are independent, embracing the ends of the respective shafts, which may thus differ slightly from each other without impairing the bite.

See also COMPRESSION COUPLING.

Fig. 625.



Le Count's Clamp Dog.

Clamp Dog. Used for finished work and many other purposes: a means of holding them in the lathe so as to partake of the motion of the head spindle.

Clamp For'ceps. (*Dentistry.*) A forceps for holding the little sheet-metal clamp

which holds the rubber dam in position on the tooth. See DAM CLAMP.

Clamp'ing Tools, Vises, Wrenches, etc. See under the following heads: —

Adjustable vise.
Alveolar forceps.
Anvil vise.
Arrow-head forceps.
Artery forceps.
Backing boards.
Band-saw brazer.
Band-saw holder.
Band-saw tongs.
Basin wrench.
Bench cramp.
Bench screw.
Bench stop.
Biscuspid forceps.
Boring bar clamp.
Boring bar wrench.
Brazing tongs.
Burner pliers.
Cabinet-maker's clamp.
Calking vise.
Cant hook.
Carpenter's clamp.
Castrating clamp.
Chemist's tongs.
Clamp dog.
Clamp forceps.
Clamp screw.
Clevis tongs.
Cock wrench.
Condensing forceps.
Cork presser.
Cow-horn forceps.
Craniotomy forceps.
Crow.
Crowded teeth forceps.
Dental forceps.
Dentes-sapientiæ forceps.
Die dog.
Die holder.
Dilating forceps.
Door clamp.
Double-jaw vise.
Double-screw vise.
Dressing forceps.
Drilling clip.
Ear forceps.
Excising forceps.
Floor cramp.
Foot vise.
Frame clamp.
Gas-tube vise.
Hand clamp.
Hand vise.
Horse-shoers' vise.
Hose wrench.
Incising forceps.
Incisor forceps.
Joiners' clamp.
Laryngeal forceps.
Main-spring vise.
Matrix pliers.
Molar forceps.
Needle forceps.
Nose compress.
Nut wrench.
Parallel vise.
Pinchers.
Pipe-fitter's vise.
Pipe grip.
Pipe tongs.
Pipe vise.
Pipe wrench.
Placenta forceps.
Plate nippers.
Pliers.
Plug pliers.
Polypus forceps.
Ratchet wrench.
Rigger screw.
Root forceps.
Rubber-dam forceps.
Sash clamp.
Saw cramp.
Saw filing clamp.
Saw-filing vise.
Screw clamp.
Screw forceps.
Screwing stock.
Screw wrench.
Scrotal clamp.
Seizing forceps.
Separating forceps.
Shackle jack.
Spanner.
Spicula.
Sudden grip vise.
Swan's-neck needle forceps.
Swivel vise.
Tape forceps.
Tap wrench.
Tenaculum forceps.
Tire-bolt clamp.
Tire shrinker.
Tire upsetter.
Tongs.
Trachea forceps.
Tube chuck.
Tube tongs.
Upending tongs.
Upright vise.
Uterine forceps.
Vesico-vaginal clamp.
Vise.
Vise clamp.
Wrench.
Wrench handle.
Y.

Clamp Mill'ing Ma-chine'. (*Fire-arms.*) A machine used for special parts of the Springfield rifle, such as the firing-pin, etc.

Clap Net. One having hinged sections; used in bird-catching.

Clap'pers. Two thick plates of iron, between which thin steel springs are placed while hot to be hardened.

Clap'per Stay. A detent for the clapper in a bell. Used in silent practice on tower or church bells; a substitute for muffling with pieces of rope.

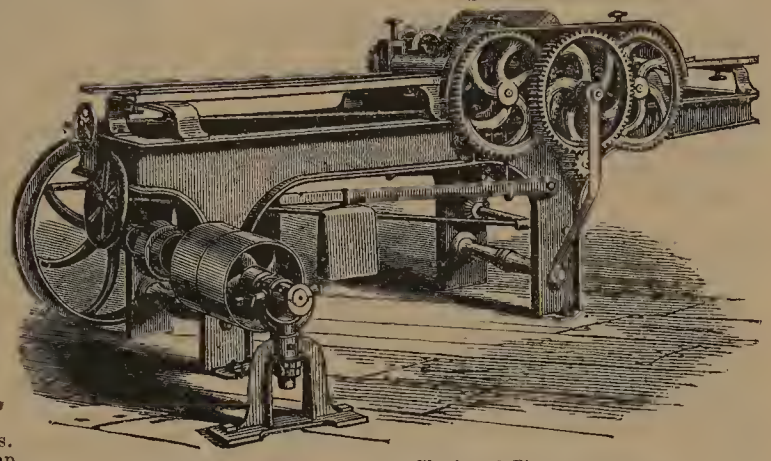
"*Engineer*" . . . . . * xlvii. 243.

Clap'board Pla'ner. A machine for planing clapboards. This, in the Eastern States, means siding or outside weather-boarding for houses. In the West, the term is applied to a 3′ or 4′ board used for roofing.

Referring to the first meaning, as the machine under consideration is of Vermont manufacture, the practice is to saw clapboards directly from the log, towards the center, making a thick and a thin edge. Such boards are 4′ or 6′ long, subsequently planed to a thickness as far back from the thicker edge as will be exposed to the weather; and the exposed edge jointed or molded.

The frame of the clapboard planer is of iron, and

Fig. 626.



Clapboard Planer.

the feed-rollers have a length for taking two clapboards at a time, *sticking* a molding on the edge of each while running through.

The countershaft and pulleys are shown on the floor alongside of the machine.

Clar'i-net. (*Music.*) A reed instrument having a compass of three and a half octaves written on the G clef. Four registers are reckoned on the clarinet: the *low*, the *chalumeau*, the *medium*, and the *high*. There are four clarinets in general use. The *small* clarinet in E ♭; the clarinets in C, B ♭, and in A. The *alto clarinet* is one in F (low); the *bass clarinet* an octave below the B ♭ clarinet.

See also CORNO DE BASSETTO.

Clasp Bend'er. A dentist's tool, for making clasps for teeth. It is a simple pliers in which the respective prongs are convex and concave so as to bend to a circular form anything pinched between them.

Fig. 627.

Dentist's Clasp Bender.

Claude Lor-raine'. (*Optics.*) A landscape mirror. It condenses or diminishes the view into a true perspective effect.

Clav'i-cle Ap'pa-ra'tus. (*Surgical.*) Braces, supporters, splints, and bandages for dislocation and fracture.

Figs. 66, 123-127, 147, 150, Part IV., *Tiemann's "Armamentarium Chirurgicum."*

Clay Heat'er. A heater for houses and halls in which baked clay is substituted for iron in order to avoid the disagreeable or injurious effects of the "burning of the air." It is a rude return to brick stoves, the ultimate quality of which is porcelain. See PORCELAIN STOVE.

Crary clay-heater . * "*Manufacturer and Builder*," xi 139.

Clay Tem'per-ing Wheel. A wheel for working clay with water to develop the plasticity. See CLAY MILL, p. 563, "*Mech. Dict.*"

Mill, *Hind*, Br. . . . . * "*Engineer*," xli. 247.
Mill and Engine, *Jackson*, Br. * "*Engineering*," xxiii. 154.
* "*Sc. American Sup.*," 1105.
Tempering mill . . . . . * "*Manuf. & Builder*," ix. 33.

Clean'ing Hole. (*Locomotive.*) A term applied to the means for cleaning; cleaning plugs

being placed in the corners of the fire-box, and blow-off cock in front.

Clear. (*Glass.*) Said of glass, ware or window, which is free from depolish, etching, or other process which dulls the surface.

The depolishing may be made by grinding, acid, sand-blast, etc.

Half-clear is applied to objects which are partly depolished.

Clear'ing Bat'te-ry. (*Brewing.*) A device used in straining the wort from the vat; operating to moderate the flow when the depth of wort is considerable.

Austrian . . "*Scientific American Sup.*," Fig. 5, * 4077.
" *Engineer*," * 1. 266.

Clear'ing Ring. (*Fishing.*) One to lower down the line to detach a hook from a root or other obstruction: or from the mouth of a fish. The latter is known also as a *disgorger*.

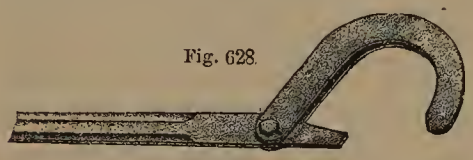
Clear'ing Stone. (*Leather.*) A fine whetstone, used to remove from the currier's knife the scratches made by the rub-stone. The Water-of-Ayr and Welsh clearing-stones are generally octagonal slips, 4″ thick, and from 6″ to 8″ long.

Clear Sto'ry. (*Railway.*) An upper row of windows in a passenger car, above the main-roof, and on the side of the raised or monitor roof.

Clear Way. Said of a valve, hydrant, etc.

One which lifts its valve entirely out of the way of obstructing the flow; not compelling the water to flow around it. Also called *full-way*.

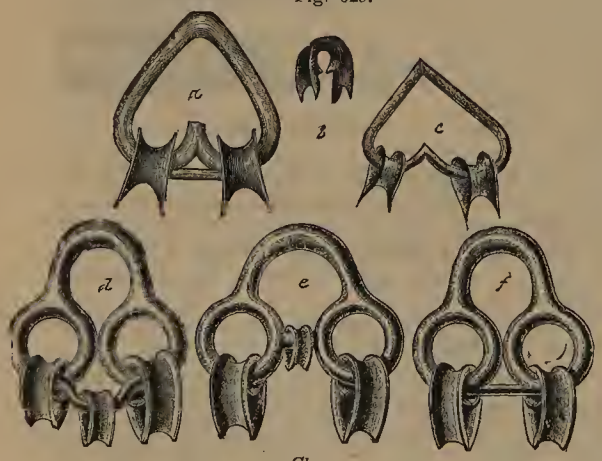
Fig. 628.



Clevis Tongs.

Clev'is Tongs. A form of pipe tongs with a swinging jaw like a cant-hook.

Fig. 629.



Clews.

a. Heart clew.
b. Clew thimble.
c. Ear-ring clew
d. Clew-bow.
e. Clew-bar.
f. Spectacle clew.

Clew. (*Nautical.*) A loop and thimble at the corner or clew of a sail. The means of attachment of the hook of the clew-tackle to the sail; the hook engaging with the loop, and the lashing passing around the thimble and the sail rope.

Clew Thim'ble. A metallic guard or sheath, (shown at *b*, Fig. 629,) over the rope forming the eye of the sail, in order to prevent chafing. In the figure a guard is placed in the interior of the thimble to fit loosely over the body of the clew to prevent the rope from chafing against the upper portion of the eye to which it is attached.

Cli'ma-tom'e-ter. An instrument for indicating the fluctuations in the conditions of sensible temperature. See instrument of Mr. J. W. Osborne, called also *Esthermoscope*, Fig. 6368, p. 2550, "*Mech. Dict.*"

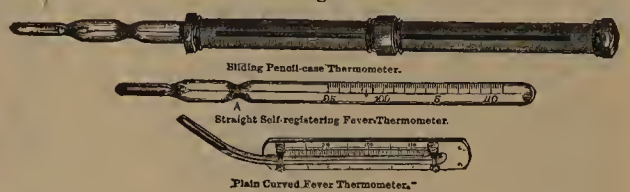
Professor Forbes's instrument, described in a paper, "*Observations relative to the Temperatures to which the Human Body is exposed*," [1] is intended to determine the "sensible warmth of the air," by which is meant, not the physical temperature which would be measured by an ordinary thermometer, but what might be termed the physiological temperature or warmth of the skin, as it is estimated by nervous persons. The questions of humidity, evaporation, movement of the air enter intimately into the question.

The apparatus consists of a cylindrical can filled with hot water and covered with a non-conductor. In this a copper rod is plunged, its upper end expanding into a cup which incloses the bulb of a thermometer. The heat of the can being assumed as constant, the rod, the lower portion of which is plunged in the can, parts at the exposed portion with its heat, and this rate depends upon the length of rod exposed and the atmospheric conditions. The length of the rod is made variable by sliding in and out of the heated vessel. The length is adjusted to give a constant thermometrical reading, and the length required to give the constant is the measure of the sensible warmth of the air.

[1] [In a letter by Prof. George Forbes, dated May, 1879, and published in the "*Journal of the Scottish Meteorological Society*," vol. v., p. 273.]

Climb'ing Ap'pa-ra'tus. See CHIMNEY.

Fig. 630.



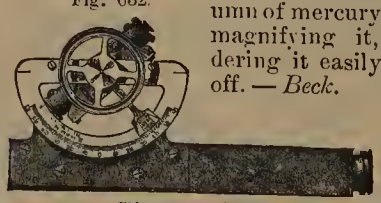
Clinical Thermometers.

Clin'i-cal Ther-mom'e-ter. A thermometer for ascertaining the temperature of the person. It is common to place the bulb in the axilla, and the bulb of the lower instrument, in Fig. 630, is curved for that purpose. The next instance above that is a straight thermometer, with a contraction in the stem at *A*, to prevent the index slipping down into the bulb. The pencil-case thermometer is peculiarly convenient. The bent stem thermometer, Fig. 631, has also an evident provision against loss of index. In the best form of thermometer the front surface of the tube is made in the form of a cylindrical lens, the focus of which is in the column of mercury, thus magnifying it, rendering it easily read off. — *Beck.*

Fig. 631.

Bent Stem Thermr.

Fig. 632.



Clinometer Level.

Cli-nom'e-ter Lev'el. An improved form of hand-level, having also an arc divided into angles of elevation and divisions for slopes.

Clip Chair. A form of chair used on some railways in England, to fasten the rail to the metallic sleeper.

The sleeper is an inverted trough, and through square holes punched in this trough a clip chair of rolled wrought iron or cast steel is slipped from the under side. The clip chair is of horse-shoe shape, one side forming a hook about

2¼″ wide, and the other side is like one jaw of an ordinary railway chair for taking a wooden railway key. The wooden key fasteus the rail tightly upon the sleeper, as well as holding the clip chair in its place.

Fig. 633.

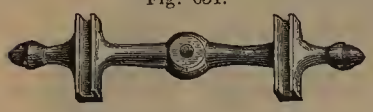
Clip King-bolt.

Clip King'-bolt. (*Vehicles.*) A clip which embraces the forward axle, and the upward extensiou of which forms a king-bolt.

Clip'ping Ma-chine'. A machine in which the clipping shears (Fig. 1330, p. 567, "*Mech. Dict.*") is driveu by power; to clip horses. Similar apparatus are used to cut hair, and to shear sheep. Fig. 4942, p. 2139, *Ibid.*

Horse clipper, *Casey*, * "*Sc. Amer.*," xli. 210.

Fig. 634.

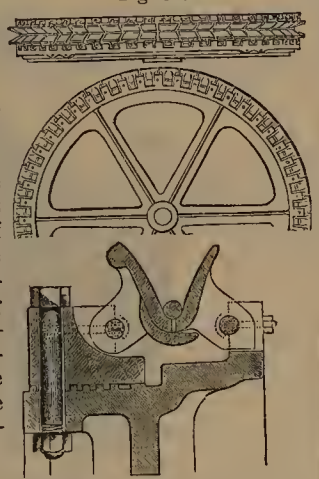


Spring Saddle Clip Plate.

Clip Plate. (*Carriage Hardware.*) A plate lying upon the spring of a carriage, and having channels above for the bows of the clip which attach it to the axle.

Clip Pul'ley. A pulley arranged for a wire rope. The perimeter of the pulley is made up of pivoted clips in pairs, and these close in upon the rope and grasp it, which prevents its slipping upon the wheel. The nipping action of the clips is upon at least half the diameter of the pulley, so that the wear of the rope is almost *nil*, the nipping action ceasing immediately and automatically the moment the rope begins to diverge from the circumference.

Fig. 635.



Appleby's Clip Pulley, for Wire Rope Transmission.

Clip Swage. (*Blacksmithing.*) A swage inserted in the hardy-hole of the anvil, used in finishing the clips on horse-shoes.

Fig. 636.

Clip Swage.

Clip Yoke. A small plate through which the ends of a stirrup-shaped clip pass, and against which the nuts are screwed.

Clock. See the following, which refer to instances of curious or otherwise remarkable clocks.

Century, *Hile*	* "*Sc. Amer. Sup.*," 688.
Curious, *Engle*	"*Iron Age*," xxi., Jan. 24, p. 3.
Lovelace, Br.	"*Iron Age*," xix., June 14, p. 3.
Guilmet	* "*Sc. Amer.*," xxxv. 371; xxxv. 401; xli. 132.
Remarkable	"*Sc. Amer*," xxxiv. 17.
Gas, Engl.	"*Sc. Amer.*," xxxix. 325.
Maker's hand-turning tool	* "*Sc. Amer. Sup.*," 1381.
Monster, *Dent*	"*Sc. Amer.*," xxxvi. 31.
Mysterious, on, *Lockert*	"*Technologiste*," xl. 79.
Rosset	* "*Sc. Amer.*," xli. 226.
Théodore	* "*Sc. Amer.*," xli. 297. "*Technologiste*," xl. 207.
Cadot, Fr.	* "*Sc. Amer.*," xxxvi. 214; xxxvii. 194. "*Technologiste*," xxxix 318.
Secrets of mysterious	* "*Sc. Amer.*," xxxvi. 405.
Dials, luminous	"*Man. & Builder*," xi. 38.
Self-winding	"*Sc. Amer. Sup.*," 1711.
Three-wheeled	* "*Sc. Amer. Sup.*," 212.
Westminster	"*Sc. Amer.*," xxxiv. 133.
Washington Observatory	"*Iron Age*," xxi., March 14, p. 9.
Without hands, *Gillett & Bland*	* "*Sc. Amer. Sup.*," 440.
Wonderful, *Meier*	* "*Sc. Amer.*," xli. 191.

See also DIAL; ELECTRIC CLOCK.

Clock Reg'is-ter Ther-mom'e-ter. A meaus for enabling the meteorologist to ascertain the temperature of any given hour of either day or night at will by automatic registration.

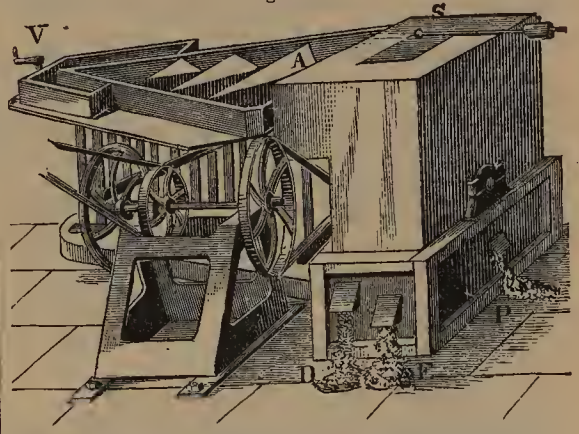
Negretti & Zambra provide for this need in a very ingenious way, which they term their "patent recording thermometer." The tube of the thermometer is bent at the middle so as to form two parallel vertical arms, and it is contracted at its union with the bulb, so that when it is turned over and upside down, all the mercury which is in the arm above the contraction runs round into the other branch of the tube, and there measures exactly the same length, and indicates the same number of degrees on the scale that it did in the first branch in the original positiou. The clock which carries the thermometer is set like an alarum. It turns the thermometer over, and so secures the register of the temperature at the hour at which its mechanism and hands are set.

"*Journal of the Society of Arts*"	1877.
"*Scientific American Supplement*"	935.

Clod Clear'er. A French machine to remove clods from grain.

The tray has a rocking motion on supporting bars, the crank making 115 turns per minute. The foul grain, etc., entering at *A* is divided to each side, bounced from side to side, and sorted according to gravity; the slope is toward the apex.

Fig. 637.



Aspirating and Vibrating Stone and Clod Clearer. (*Hignette, Paris.*)

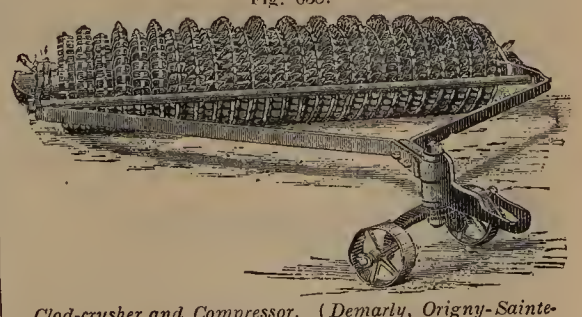
Stone and clods leave at the point *V*, the grain passes into the aspirator, where it is sorted by quality: *D* second quality, *E* heavy waste, *P* second waste; the good wheat has its discharge on the other side (not shown).

See Knight's Report Paris Exposition 1878 . . * v. 199.

Clod Crush'er. A rough-faced roller for breaking clods iu the field.

Dr. Knight's report on Class 76 at the Paris Exposition of

Fig. 638.



Clod-crusher and Compressor. (*Demarly, Origny-Sainte-Benoite, France.*)

1878, contains views of the following (see "*Paris Exposition* (1878) *Reports*," vol. v., pp. 99–101) : —

Clod-crusher, *Lowcock & Barr*, Engl.
"Excelsior" clod-crusher, *Picksley & Sims*, Engl.
Crosskill clod-crusher, *Puzenat*, Fr.
Clod crusher and compressor, *Demarly et Cie*, Fr.

Fig. 638 shows the Demarly implement. Besides the unequal sizes of the roller sections, in alternate order, they have an ability to slip transversely upon the axis. By this means, though of varying size, they may present themselves in straight line upon a level surface; either may lift in yielding to a large clod; and, as the surface rotation of each is equal, the rate of motion of the larger ones on the common axis is slower than that of the smaller rings, and, therefore, any clods getting between them are ground to powder, and the spaces between them are not choked.

Randell's clod crusher, Br. . * "*Engineering*," xxviii. 35.

Cloi-son-né. 1. (*Fine Art Metal Working.*) A pattern is raised on a metallic surface by means of wire or strips welded on to it, and enamel spread in the spaces, *cloisons*, between the raised metal.

A species of inlaying resembles it in this respect, that the lines are engraved, wires laid into them and the surface burnished down to hold the wire in position.

Champ-leve has lines engraved in the metal and filled with enamel.

Shushikuwan . . . . . "*Technologiste*," xli. 519.

See lists Fine Art Metal Working; Art in Various Materials; Ceramics.

2. A coin on which a subsequent impression has been imposed on the previous one.

Clos'ing Ma-chine'. A sewing machine for boot-closing, stitching soles to welts, and for light harness work. The machine makes a lock-stitch with two threads, both sides alike.

Cloth-cut'ting Ma-chine'. Of the three power cloth-cutting machines shown at the Centennial Exhibition in 1876 : —

Albin Warth's machine employs a reciprocating cutter blade in a turning head at the end of a pivoted arm guided on a track or rail at the side of the table on which the cloth rests. It operates better than a rotary knife on curved lines and corners.

Sanson's machine is a spring-arm band-saw machine, accurate and swift.

Fenno employs a rotary cutter at the end of a universally movable arm.

See the following references : —

Cutter band knife,
Powis Bale & Co., Br. . . * "*Engineer*," xlix. 235.
Cutting machine, *Sanson*, Br. * "*Engineer*," xli. 393.
Cutting machine, *Sanson*, Br. * "*Sc. American Sup.*," 4312.
Warth . . . . . "*Thurston's Vienna Rept.*," iii. 320.
* "*Engineer*," xliii. 320.
Cloth finishing machine,
Pierron & Dehaitre, Fr. . . * "*Sc. Amer. Sup.*," 4023.
Folding machine (Fr.) . . . * "*Sc. Amer.*," xxxiv. 178.
Inspector. Bolting cloth, *Deal.* * "*Sc. American*," xl. 326.
Press, *Boomer & Boschert* . . * "*Scientific Amer.*" xlii. 242.
Testing machine, *Riehl* . . . * "*Manf. & Builder*," xi. 178.
Hausner . . . . . * "*Sc. Am. Sup.*," 1236.

Clothes Dry'er. An application of the centrifugal machine to the partial drying of clothes, preliminary to the *drying closet*, which see.

The *essoreuse* shown in Fig. 639 is made to go by hand or by power, being one of the smaller sizes.

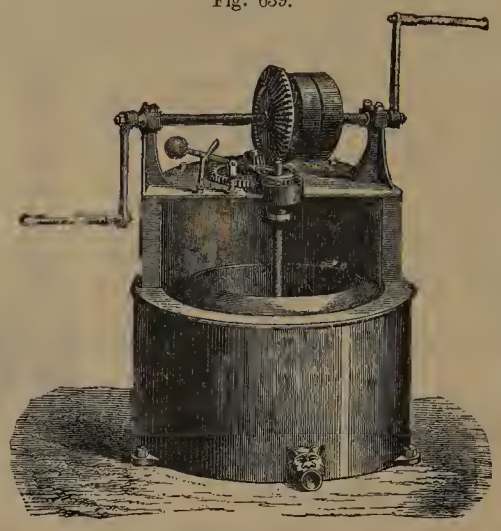
Brooks . . . . . "*Scientific Am.*," xxxiv. 99.
Clothes wire-fastener, *Almont* * "*Scientific Am.*," xxxv. 166.
Clothes pins . . . . . * "*Scientific Am.*," xxxvi. 227.

Clothes Pin. The machinery used in making clothes pins consists of

Bolting-up saw for working log into slabs.
Splitting-saw for working slabs into rods.
Cross-cutter or cutting-up machine.
Lathe for rounding.
Slotter.

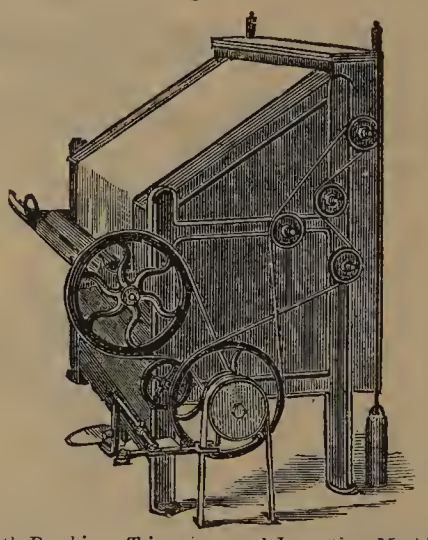
Cloth In-spect'ing Ma-chine'. A machine in which the cloth is exposed in a smooth, inclined surface to the view. It may also be brushed, burled, or trimmed during momentary stoppage of the automatic motion.

Fig. 639.



French Clothes Dryer. (*Beaume à Boulogne.*)

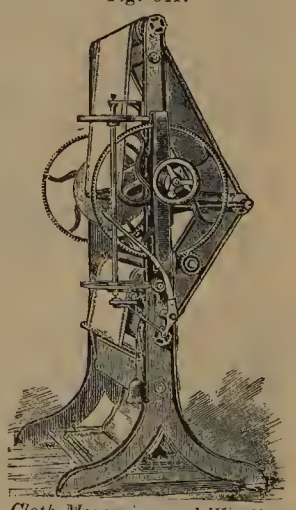
Fig. 640.



Cloth Brushing, Trimming, and Inspecting Machine.

Cloth Meas'ur-ing Ap'pa-ra'tus. A winding machine which takes the cloth from the bolt or pile, runs it over a measuring roller, then over stretching rollers at the back of the machine, and from thence to the winding jaws which hold the board on which it is wound. The measuring roller has a worm which operates the vertical shaft, on the top of which is a dial which indicates the length wound, and the pointer is set to zero for each operation.

Fig. 641.



Cloth Measuring and Winding Machine.

In the cloth-measuring machine of *White, Child, & Co.*, of London, the cloth runs upon a smooth and level table and underneath a wheel of known circumference, the revolutions of which are counted by

worm gearing and dial. It is adapted for measuring and rolling cloth in salesrooms.

"*Scientific American*" . . . . . * xxxix. 54.

Cloth Press. A machine for pressing cloth *in transitu* or in bolt.

Nussey & Leachman, Leeds, England, make a powerful automatic machine, in which the woolen cloth is fed intermittingly between steam-heated platen and bed-piece. These are driven together with a force of 1 ton to the square inch, by a steam-pump acting as a hydraulic press. The whole surface is such that the aggregate pressure is 153 tons, and the pressure is maintained for 15″. The platen then retreats, the cloth is automatically advanced, bringing a fresh position between the pressure surfaces, which are again advanced, and so on. The cloth at the feed-end is fed over smoothing rollers. The machine was shown at the Centennial Exhibition.

In the continuous cloth press of *Harwood & Quincy*, of Boston, Mass., the cloth goes direct from the shearing machine to the press where it is brushed and pressed simultaneously.

The cloth to be pressed passes over bars and friction rollers, then over the upper part of a brush, and thence between a roller and concave bearing, and finally over another roller and the plaiter. The bearings are heated or not, as desired; the pressure may be brought up by the lever to 6 tons. When no pressure is required, the machine may be used as a brushing frame only. For the purpose of steaming the fabric it is necessary to heat the roller, and to cover it with a thick felt. — "*Textile Manufacturer.*"

The machine of *M. Hirst* is described in *Laboulaye's* "*Dictionnaire des Arts*," etc., article "*Laine*," * vol. ii., ed. 1877.

Boomer & Boschert . . "*Scientific American*," * xlii. 242.
"*Scientific Amer. Sup.*," * 2326.

Cloth-shear'ing Ma-chine'. A machine to cut the nap of undressed cloth. See pp. 575, 576, and Figs. 4922–4924, p. 2135, "*Mech. Dict.*"

For French woolen cloth-shearing machine, see Figs. 1339–1351, article "*Laines*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome ii., ed. 1877. Machines of

Lewis & Davis . . . . . Figs. 1339–1343.
Davis . . . . . Figs. 1344–1348.
Poupart . . . . . Figs. 1349–1351.

Cloth Stretch'ing Ma-chine'. A machine for stretching and softening fabrics.

In the machine of *Devilder* (France) several cylinders and rollers are supported by a cast-iron frame, and operated by power transmitted by a belt and gearing. The necessary pressure on the goods is produced by a weight, pulleys, and levers. The goods, rolled on the lower cylinder in the rear part of the machine, are carried between a zinc cylinder and a wooden roller situated directly above the lower cylinder. The zinc cylinder runs in a trough filled with water. By this means the necessary degree of moisture is imparted to the goods. They are next taken up by a bar at the top of the machine, which may be regulated so as to increase or lessen the tension of the goods. From this bar the goods pass to the stretching cylinder, which is composed of sixteen copper plates revolving around, and alternately approaching to and receding from, a common axis. The approach takes up the first half of the revolution and the return the second half. The goods, by this means, are well stretched; they are afterwards rolled on a wooden cylinder below the stretcher. — * "*Revue Industrielle.*"

"*Scientific American*" . . . . . * xl. 227.

Cloth Test'er. A machine for testing the strength of cloth by direct pull.

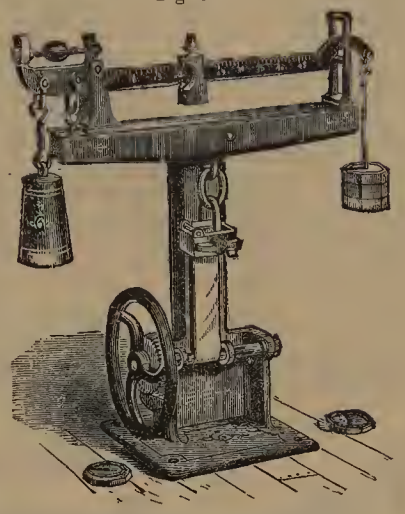
Riehlé Brothers' cloth-testing machine is shown in Fig. 642. One end of the sample of cloth, paper, or twine is inserted in a clamp attached to the weighing mechanism and the other end wrapped around a roller. The strain is put on by turning a hand-wheel, and the beam kept in equipoise by shifting the running weight. The strain is continued until the sample breaks, the result of the test being indicated on the scale in pounds. The scale levers are inclosed in the box in the upper part of the frame.

Yarn, fiber, and paper testers operate in a similar manner. See list under MEASURING, ETC., INSTRUMENTS

"The official test of resistance of tissues and cordage shows the nature of the yarn and the quantity of matters contained therein by the following triple method: —

"*a.* The weight of the tissue per square yard is taken after the samples have been well dried in the stove or in the sun.

Fig. 642.



Riehlé Brothers' Cloth Tester.

"*b.* The number of threads in warp and weft is ascertained by the ordinary thread counter of a quarter-inch field.

"*c.* The resistance to traction of either tissues or cordage is measured by means of an apparatus which has two jaws, between which the tissue or cord is fixed, one jaw being stationary and the other connected with a lever, which is loaded until the sample breaks. In France the apparatus used is the dynamometer of Perreaux. For tissues the trials are made with bands 16″ long and 2″ wide, one cut lengthwise and another crosswise of the stuff

"The following are the conditions required by the navy and public offices for the following principal tissues: —

Kind of Tissue.	Threads per centimeter.		Weight per square meter.	Resistance of a band 5 cm. wide.	
	In the Warp.	In the Weft.		Lengthwise.	Crosswise.
			k.	k.	k.
Hand loom cloth	–	–	435	220	230
Hand loom cloth	–	–	345	130	140
Tilt cloth	32, 33	10, 11	540–560	270	330
Double yarn hammock cloth	–	18	330–370	200	290
Sail cloth, No. 1	22	7	550	275	410
Sail cloth, No. 6	24, 25	10	350	170	255
Sail cloth, No. 8, single yarn	16–18	13, 14	270	135	200

"After experimenting on samples well dried at a temperature of about 30° C., the same should be repeated with others damped with water, which, of course, generally offer greater resistance than dried samples."

The cloth tester of MM. Chavin and Marin-Darbel, of Paris, is shown in "*Scientific American*," * xxxix. 211.

The cloth tester used by M. Giffard in testing the fabric of his captive balloon, Paris, 1878, is shown in "*Scientific American*," * xxxix. 194.

See also *Riehlé* . * "*Manufacturer and Builder*," xi. 178.
Hausner . * "*Scientific American Sup.*," 1236.

Cloth-Wind'ing Ma-chine'. See CLOTH MEASURING AND WINDING MACHINE; CARPET WINDER.

Clouds, Ap'pa-ra'tus for Meas'ur-ing heights of. John Harmer of Wick, near Arundel, Britain, has invented a method of estimating the height of clouds by photography and the stereoscope. Described in "*Nature*," Dec. 30, 1880, pp. 145, 195.

Clov'er Leaf Sight. A rear gun-sight having side lobes, which slightly resemble two foils of the clover leaf.

Fig. 643.

Clover Leaf Sight.

Club'-Foot Ap'pa-ra'tus. (*Surgical.*) Apparatus to bring a constant pressure upon the foot to bring it to symmetrical position. The talipes apparatus varies according to the nature of the deformity.

The figures following refer te *Tiemann's "Armamentarium Chirurgicum."*

For talipes varus	Fig. 63, Part IV.
For talipes valgus	Figs. 64, 65, Part IV.
For talipes calcaneus	Figs. 67, 68, Part IV.
Artificial muscles	Fig. 76, Part IV.
Apparatus to evert the feet	Fig. 77, Part IV
Apparatus for contracted tendo achillis, talipes equinus	Fig. 62, Part IV.
Shoe for partial paralysis of the foot	Fig. 143 *a*, *b*, Part IV.
Club foot extension apparatus	Fig. 23, supplement.
MacOwen's chisel for bow legs, etc.	supplement.

Clump. A thick outer sole attached by springs or cement to the ordinary boot sole.

Clus'ter Spring. (*Railway.*) One formed of a number in a group. A *group spring.* See Fig. 1143, p. 483, "*Mech. Dict.*"

Clutch. (*Nautical.*) The reëntering angle at the junction of the arm and shank of an anchor. The *throat.* See *d*, Fig. 191, p. 96, "*Mech. Dict.*"

Clutch Coup'ling. Fig. 644 shows a clutch

Fig. 644.

Clutch for Countershafts.

coupling as applied to countershafts. It has no shock in starting or reversing, nor any sudden tension of the belt. The shipper slide slips the cone against the clutch jaws, expanding them and bringing the surfaces in contact to produce motion. See also FRICTION CLUTCH.

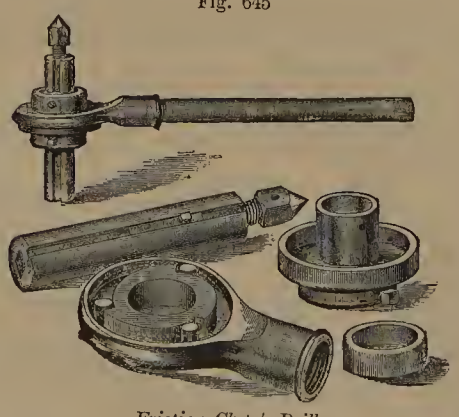
For rolling mills, *Beauregard*	* "*Min. & Sc. Press,*" xxxvii. 65.
Gear, *Burrell*, Br.	* "*Engineer,*" xlvi. 442.
Pulley, *Hunter*	* "*Scientific Amer.,*" xl. 275.

Clutch De-tach'er. A device for throwing off the clutch in a rolling mill train.

Lloyd	* "*Iron Age,*" xxv., June 17, p. 11.

Clutch Drill. A drill the motion of which is obtained by a lever which binds upon the stock in the forward motion and runs free on the backward

Fig. 645



Friction Clutch Drill.

motion; pins on the lever head traveling inclines on the hub of the drill stock. The head can be moved from end to end of the stock, a feather traveling in a slot. The strain is divided on three points around the spindle.

Clys'ter Ap'pa-ra'tus. An enema syringe.

Coach. 1. (*Railway.*) A first class passenger car, as distinguished from a drawing room car, or second class.

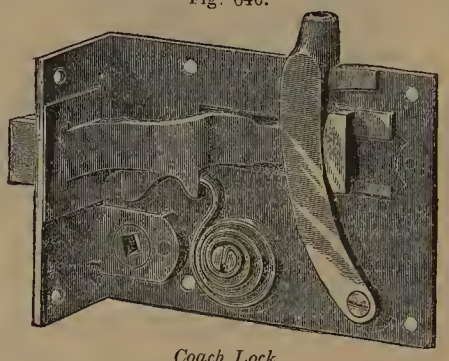
2. A passenger vehicle plying for hire.

Herdic	"*Scientific American Supplement,*" 3901.		
Murch. Patents	147,421.	151,240.	
	152,244.	149,779.	
See also CAB.	154,572.	7,166.	7,445.

3. A private close carriage of size and pretensions.

Coach Bit. (*Manége.*) One having large scroll or straight cheeks made stationary on the mouth-piece, loops for the driving rein being placed at different distances from the mouth-piece, by which the leverage is increased or diminished.

Fig. 646.



Coach Lock.

Coach Lock. A spring latch operated either by the cross-bar handle on the exterior, or by a lever from within side the carriage.

Fig. 647.

Coach Screw.

Coach Screw. A peculiar form of screw, with a V-thread and a square head like that of a machine bolt.

Coach Whip. (*Nautical.*) Another name for the pennant.

Coak. (*Nautical.*) The metallic strengthening piece in the middle of a block-sheave; pierced for the pin.

Coal Dust Burn'ing Grate. A grate peculiarly constructed to burn the anthracite slack, which has accumulated to such an enormous extent in the anthracite coal regions of Pennsylvania and Wales. The grate has usually a large surface and moderate intervals between bars, and the dust is distributed by a fan-like motion of the shovel. In some cases it is introduced in a gentle and constant shower by mechanical means. See WASTE-BURNING LOCOMOTIVE.

Coal-dust fuel	"*Scientific American,*"	xxxv. 179; xxxviii. 33.
Loiseau	"*Scientific Amer.,*"	xxxiv. 163; xxxviii. 116.
Furnace, *Stevenson*, Br.	* "*Engineer,*" xliii. 335.	
	* "*Scientific American Sup.,*" 1295.	
Locomotive, *Wootten*	See WASTE-COAL LOCOMOTIVE.	
Coal economizer	See ECONOMIZER.	

Coal El'e-va'tor. The projecting track *C* supports a carriage *B*, over which and through the running-block *A*, the hoisting rope runs, the end being fastened to the carriage *B*.

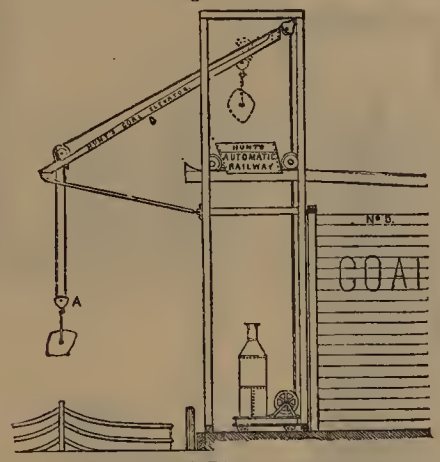
When the hoisting engine starts the rope in motion, the running-block *A*, with the loaded tub attached, rises vertically from the hold of the vessel until the block *A* strikes the carriage *B*. The engine continuing in motion, draws both the carriage and the bucket of coal up the inclined track *C*, until the bucket is over the bin or car, where it is dumped. The rope is then slackened and the carriage and empty bucket run back on the track to *B*, when the carriage is stopped by an adjustable chock and the bucket descends to the hold of the vessel to be refilled. The running block *A* is hooked to another tub already filled and ready to be hoisted.

When not in use, the whole track *C* swings on hinges back against the side of the building entirely out of the way.

The performance is usually 25 to 30 tons per hour.

In *Mariller's* hydraulic coal-hoist, used at Hull, England,

Fig. 648.



Coal Elevator.

the coal wagons are hauled by a *Brotherhood* capstan on to the rising platform, and are hoisted by a hydraulic ram to the required level, when they are run on to the middle platform over the hopper, and are discharged by opening the hopper doors and by tipping with special hydraulic apparatus for end-tip wagons. While the wagons are being discharged, the lifting platform is descending, and is lifted again with another wagon by the time the previous one is empty. The empty wagon passes on to the second moving platform, and, by means of its weight, controlled by a hydraulic brake, is lowered to the ground level, and passes out on to the empty siding. The brake ram, being connected to the hydraulic main, is of sufficient power to raise the lowering platform again to the top without the expenditure of any power beyond that obtained from the empty wagon in its descent. The tipping arrangements allow of the wagon being tipped in either direction, and the hoist is fitted with the usual appliances for adjusting the hoppers and coal chutes.

With properly hoppered wagons, constructed to discharge the coal freely, 300 tons of coal per hour can be shipped by the hoist.

Colliery hoist at Épinac, France * "*Engineering*," xxvii. 367.

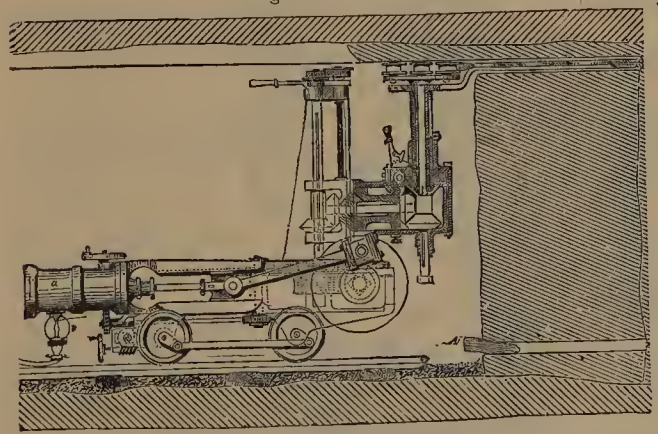
Coal Gas Test'er. See GAS-TESTING APPARATUS, *infra*. See also Fig. 651, next page.

Coal Min'ing Ma-chine'. The coal undercutting machine of Lechner protrudes into the coal a horizontal shaft, armed with cutters and driven by chain-gearing. It advances straight into the breast of coal.

The Brown machine traverses along the breast and undercuts to a depth of 4′. It uses cutters on an endless chain protruded into the coal.

The Gledhill machine (British) also advances along the breast. The endless chain of cutters passes over a jib which extends into the coal, and the jib has a capacity for a swinging motion in a horizontal plane so as to cut out at the end.

Fig. 649.



Hurd's Coal-mining Machine.

The machine of Hurd & Co., of Wakeford, Britain, has also a jib which protrudes into the coal and around which the chain of cutters passes; but the machine is capable of cutting out all the four faces of the drift by revolving the head of the machine in a vertical plane so as to present the jib below, above, or on either side. The machine has two cylinders, 6″ diam., 12″ stroke, and works by compressed air. Motion is given to the cutters by bevel gearing, and the shaft driving the cutters is capable of being revolved in a vertical plane about the horizontal shaft.

The Paytou & Holmes machine (London, England) has a species of saw jib having a number of teeth to which a peculiar pecking motion is given by means of short curves or eccentrics. The jib (or saw) has a swinging motion in cutting in or out and when sunken in the face to its full depth the machine is traversed on rails along the face of the breast.

See notices under the following references: —

Report on coal-mining machinery by A. Jottrand, "*Centennial Exhibition Reports*," Group I., vol. iii., p. 338 — including —

McDermott's coal-drilling machine	* p. 340.
Gledhill's coal-cutter	p. 341.
Holmes & Payton's coal cutter	* p. 342.
Brown's coal cutter	* p. 347.
Coal-breaker, *Hull*, Br.	* "*Engineering*," xxix. 135.
Chute for tenders	* "*Railroad Gazette*," xxi. 275.
Coaling	* "*Railroad Gazette*," xxii. 193.
Cutting	"*Scientific American Sup.*," 1810.
"Monitor," *Brown*	* "*Eng. & Min. Jour.*," xxiv. 365.
	* "*Scientific Amer. Sup.*," 1702
Lilienthal	* "*Scientific Amer. Sup.*," 2587.
	* "*Engineering*," xxvi. 498.
Lechner	* "*Engineering*," xxix. 78.
	* "*Eng. & Min. Jour.*," xxvi. 130.
	* "*Scientific American*," xlii. 81.
Payton & Holmes	* "*Eng. & Min. Jour.*," xxi. 286.
Discharging, *Beuvry*, Fr.	* "*Engineering*," xxvi. 98.
Getting, Scotland	* "*Scientific Amer. Sup.*," 3754.
Handling, Sugar Refinery	* "*Eng. & Min. J.*," Aug. 23, 1879.
Hoist, Nuneaton, Br.	* "*Engineer*," xliv. 184.
Hydraulic, Br.	"*Iron Age*," xx., Aug. 16, p. 7.
Hydraulic hoist	* "*Engineering*," lvii. 231.
Mining, Schuylkill, Pa.	* "*Eng. & Min. Jour.*," xxiii. 40, 56, 72, 88.
Screen, spiral, *Schmitt*	* "*Engineer*," xlvii. 416.
Shipping, *Smith*, Br.	* "*Engineering*," xxviii. 373.
Tipping, *Rigg*	* "*Scientific American*," xli. 290.
Truck, Penn. Railway	* "*Engineering*," xxv. 8.
Washing, *Robinson & Son*	"*Iron Age*," xix., June 7, p. 1.
	"*Am. Manuf.*," Feb. 7, 1879, p. 11.
Stutz	* "*Iron Age*," xxi., June 13, p. 1.
Evard, Fr.	* "*Engineering*," xxix. 42.
Molières, Fr.	* "*Engineering*," xxix. 84, 96.
Bessiége, Fr.	* "*Engin'g*," xxix. 122, 201, 260.
Washing, Osterpey, Ill.	* "*Eng. & Min. Jour.*," xxii. 88.

Coal Oil Fur'nace. See PETROLEUM FURNACE.

Coal Sledge. A peculiarly formed hammer of from 5 to 8 pounds weight, used in coal mining and breaking lumps.

Fig. 650.

Coal Sledge.

Coal Test'ing Ap'pa-ra'tus. An apparatus by which the director of a gas-works may readily ascertain the quality of coal.

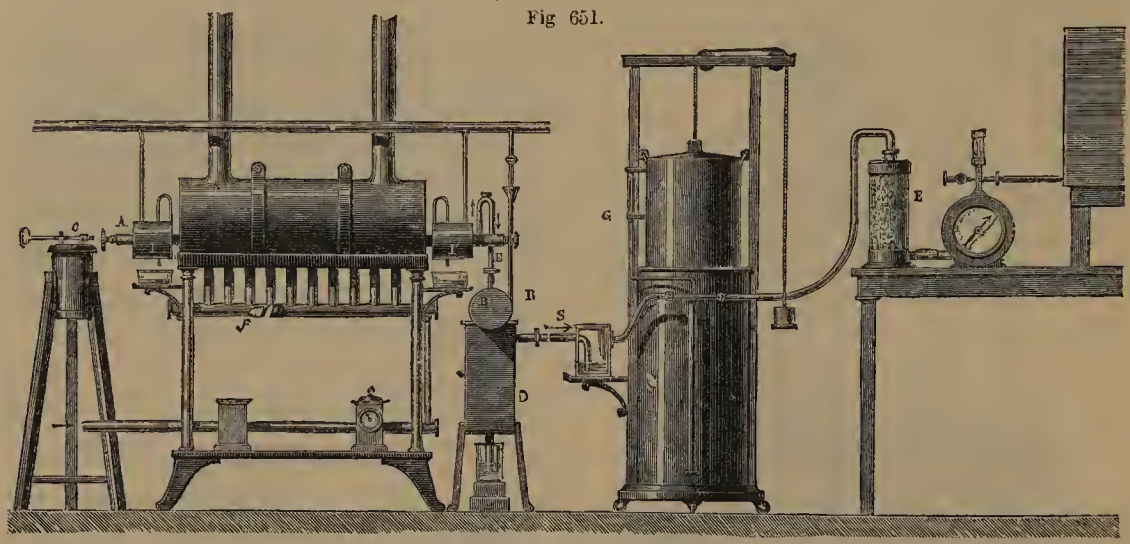
Fig. 651 shows an apparatus, designed by M. Andouin of Paris, by which can be determined, in less than an hour, the quality of coal from the point of view of the production of gas, the quantity of gas and coke, the lighting power of the gas produced, and whether the purification of the gas is easy or otherwise.

This apparatus serves not only to determine the value of different coals, but also to assist in judging of the conditions under which the gas-works is operated day by day, in comparing results under diverse treatment. It also enables the director to determine whether the difference in results is due to change in the nature of the coal or to changes in the mode of operation in the gas-works.

The mode of operating the apparatus is as follows: —

An average sample of the coal being selected, is crushed and charged into an iron crucible. The weight of a charge is 100 to 200 grams, or more, according to the size of the ap-

Fig 651.



Andouin's Coal-testing Apparatus.

paratus. The iron tube which has the function of the retort is raised to the required temperature by means of the special means indicated in the figure.

The furnace is heated by gas, which allows the requisite degree of temperature, a bright red, to be maintained steadily by means of a gas regulator which determines the pressure, shown by a manometer communicating with the tube *f*, which brings the gas.

As soon as the required temperature of the furnace is attained (in about half an hour after lighting the gas), which is determined by a pyrometer, the tubular retort is introduced and the opening A closed. The gas, as it is disengaged, passes to the gas-holder G after parting with its tar and ammoniacal water; the holder has a capacity of about 60 liters and maintains a pressure at 0°. The distillation terminated, the gas, which is measured in the holder, is conveyed to the purifier and then to the photometer to be tested for quality.

The retort is withdrawn from the chamber and rapidly cooled, and the weight of the coke is readily ascertained.

The right hand portion of the apparatus shown in Fig. 651 is ordinarily at some distance from the retorts, but they are shown close together for convenience of illustration. The break is visible near the arrow S. B is the washer; D the condenser; the cooled gas escapes by the pipe S to the gas-holder G, thence by the purifier E and the meter to the photometer. I I are the chambers in which cold water circulates around that part of the retort outside of the furnace. C is a screw to close the tube.

Coal-still, *Clements*, Engl. * "*Scientific Amer.*," xxxix. 85.
Coal-tar still . . . . . "*Scientific Amer. Sup.*," 2895.
"*Scientific Amer.*," xxxiv 213.
Scotland . . . . . * "*Scientific Amer. Sup.*," 2740.

Coal-tip'ping Ma-chine'. One for discharging the corves or mine cars down a grated incline into railway cars or boats. The screen removes grades of dust and small coal which fall into cars or receptacles beneath.

Riggs . . . . . * "*Scientific American*," xli. 290.

Coal-whip'ping Ma-chine'. A form of hoisting apparatus for quickly lifting the large loaded buckets out of a ship's hold. It was formerly done by a set of men called coal-whippers, who used the simple form of apparatus known as a whip. Described on page 2770, "*Mech. Dict.*"

In the coal-whippers' machine the cylinders act directly upon the barrel, and an up-and-down rope is used; the engine and boiler are made separate, and are as light as possible, so that they can be taken in a boat alongside a sailing ship, and readily hoisted on board by the ship's tackle.

In some cases the whole of the winches required to work the cargo in and out of the ship are driven from one engine placed amidships by means of a high-speed cord carried along the deck, and protected by wooden casings.

Co'ap-ta'tion Splint. (*Surgical.*) A stiff cradle bandage to hold the broken ends of bones in apposition. See SPLINT.

Co'balt Pla'ting. Cobalt electro-plating is done in a bath of a neutral solution of the double sulphate of cobalt and ammonium (*Gaiffe*), or the chloride of cobalt combined with the chloride of ammonium and magnesium, or the sulphate of cobalt with sulphate of ammonium or sulphate of magnesium (*Adams*). See also ELECTRO-PLATING.

"*Engineering and Mining Journal*" . . . . xxvi. 136.
"*Scientific American Supplement*" . . . . . 207.

Cob Stack'er. An attachment to a power corn sheller to raise the cobs from the machine and pile them at a distance. See CORN SHELLER.

Cock Al-loy'. The Society of Mechanical Engineers, of Vienna, have decided upon the following alloys as best suited for cocks and valves.

	No. 1.	No. 2.	No. 3.
Copper	84.	83	80
Tin	22.9	17	18
Zinc	8.4	–	2
Lead	4.3	–	–
Iron	.4	–	–
Total	120	100	100

The freshly cast alloy to be cooled rapidly with water.

Cock valve, *Mayer*, Austria * "*Engineering*," xxx 259.

Cof'fee Clean'er. 1. A machine for rubbing the parchment envelope which incloses the associated seeds.

2. A machine for cleaning mold, dust, and trash from raw coffee.

Stafford's coffee cleaner (Br.) has a magnetic nail detector to remove nails. The inclined sieve removes dust.

Cleaning . . . . . "*Scientific American*," xl. 368.
Dryer, *Guardiola* . . * "*Scientific American*," xxxvi. 83.
Pot, *Sherwood* . . . * "*Scientific American*," xxxvii. 182.
Place . . . . . * "*Scientific American*," xxxix. 168.
Huller, *Guardiola* . . * "*Scientific American*," xxxvi. 83.
Washer, *Guardiola* . . * "*Scientific American*," xxxvi. 82.

Cof'fee Cool'er. An apparatus for cooling coffee after being roasted or kiln-dried after treatment to clean it.

The machine consists of a large blower or exhaust, 26″ in diameter, and a large double-bottomed box, the false bottom being of heavy wire cloth. The box is supported on two wheels, so that it may very readily be moved to receive the material from the roaster or dryer; and so arranged that, when the open end is attached to the open side of the blower, the air is exhausted from between the bottoms, and so drawn down through the material, and cooled, without dust or smoke entering the room; the same being blown into any chimney or flue, or out at any convenient opening. — *Burns.*

Cof'fee Hul'ler. A machine for operating upon the coffee berry to remove the husk, or parchment envelope of the grains.

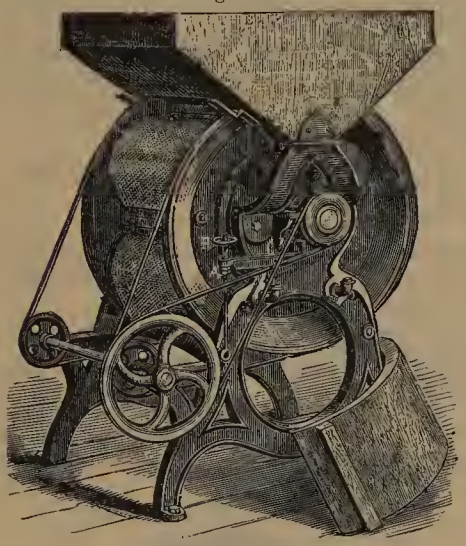
In Lombard's coffee huller the coffee is placed in a hopper that discharges on an endless chain apron which carries it in contact with a system of elastic pads. The pads treat each berry according to its size, retiring and returning readily as the grain of varying sizes pass under them.

The coffee, as it leaves the apron, is riddled by a screen below, being at the same time cleaned by a fan working in connection therewith, and falls into a well, from which it is elevated by buckets on an endless belt, and discharged on to a second endless chain apron that draws it under a stiff brush, by which the berries are polished.

The berries then fall on a second riddle that separates them according to size, and they are discharged at their separate spouts.

Cof'fee Mill. In the granulating coffee-mill,

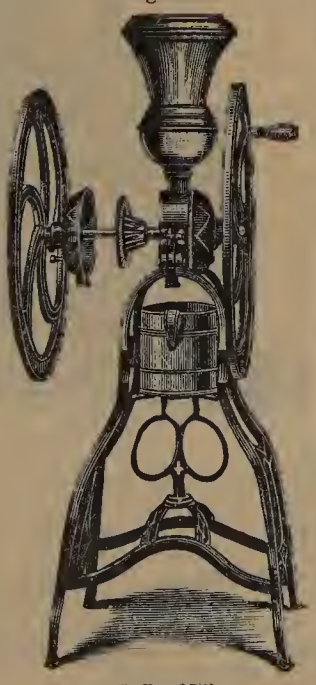
Fig. 652.



Granulating Coffee Mill.

Fig. 652, the berries are cracked by a coarse roller, and the grains removed by the revolving sieve as soon as they attain a certain degree of fineness, the object being to obtain uniformity of size. The sieve revolves on flanged friction-wheels, the toothed roller and concave do not touch when the machine runs empty. The sieve is made up of 6 semi-circular divisions, which successively return their quotas of coarse stuff to the grinder.

Fig. 653.



Coffee Mill.

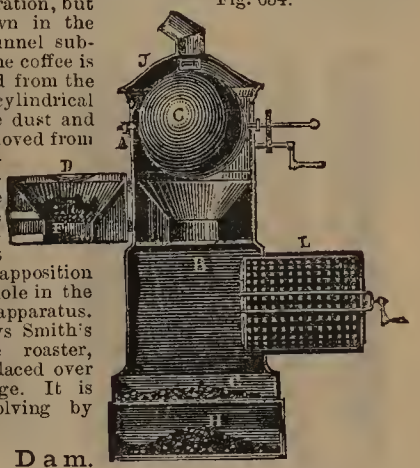
Fig. 653 is a retailer's mill, the roller axis shifted, one cover removed, and the cutting disk exposed. The coffee from the hopper above passes between the attrition surfaces and falls into the tin vessel.

Cof'fee Roast'er. A multitude of small domestic and larger warehouse coffee roasters are in the market.

A French coffee roaster has a spherical chamber of glass, rotating over a special small furnace.

The coffee roaster of Hignette (Paris) has a globular vessel *C*, in which the coffee is roasted by the heat of a brazier, *D*, which is placed beneath it during the operation, but retired, as shown in the figure, and a funnel substituted when the coffee is to be discharged from the roaster into the cylindrical sifter, where the dust and pellicles are removed from it. The globular roaster receives the coffee from above when the opening is brought into temporary apposition with the flue hole in the cover, *J*, of the apparatus.

Fig. 654.

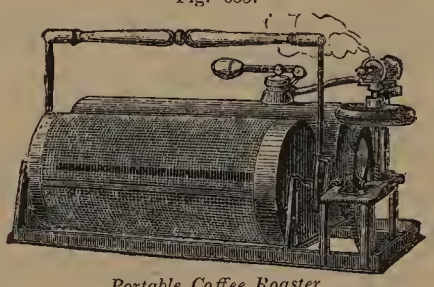


Coffee Roaster and Sifter. (*Hignette, Paris.*)

Fig. 655 shows Smith's portable coffee roaster, adapted to be placed over a stove or range. It is automatic, revolving by steam pressure.

Cof'fer Dam. (*Hydraulic Engineering.*) An inclosure from which water is pumped, to expose the surface of the ground or bottom.

Fig. 655.



Portable Coffee Roaster.

The coffer dam at dam No. 4, Kanawha River improvements, is shown in "*Report of Chief of Engineers, U. S. Army*," 1878, * ii. 467.

Conn. River, *Burrall* . * "*Van Nostrand's Mag.*," xiv. 366.
Harlem River . . . "*Iron Age*," xvii., May 11, p. 15.
Portable, "Centennial" * "*Iron Age*," xix., Feb. 22, p. 1.
Walsh, New York . . * "*Scientific American*," May 8, 1875.

Coil. (*Heating.*) 1. A convoluted pipe used as a heater, evaporator, condenser, as the case may be. The names of coils are derived from their construction, shape, purpose, and application. See the following: —

Bell.	Manifold.
Box coil.	Pipe stand.
Branch.	Radiator.
Circular tank coil.	Return bend.
Coil hanger.	Return bend coil.
Coil heater.	Ring plate.
Coil plate.	Sleeve.
Coil screen.	Soap coil.
Coil stand.	Spiral tank coil.
Condensing coil.	Square spiral tank coil.
Cone joint.	Square tank coil
Double cone coil.	Taper screw joint.
Flat coil.	Tee.
Flat square coil.	Trunnion coil.
Heater coil.	Tuyere coil.
Helical tank coil.	Tymp coil.
Hour-glass coil.	Vertical tube coil.

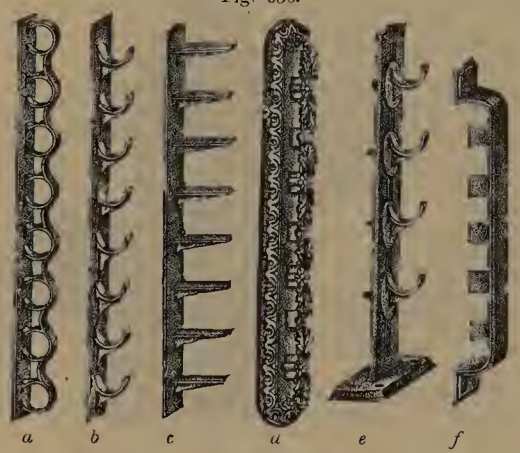
See also instances under CONDENSER, REFRIGERATOR, RADIATOR, FEED-WATER HEATER, etc., etc.

2. (*Electricity.*) *a.* The bundle of soft iron wires in the center of the helix. *b.* The wrapping of insulated wire around the core of an electro-magnet. Fig. 2672, "*Mech. Dict.*"

Coil'ing Ma-chine'. The ovens and machine for coiling bars, for making tubes for cannon, is shown in Plate II., Appendix I. *d*, "*Report of Chief of Ordnance, U. S. A.*," 1877, pp. 400, 412. See also Appendix L, Fig. 75, and p. 549, same report.

Coil Plate. A plate with hooks or rings to support the horizontal coils of a radiator; a steam or hot-water heater, evaporator, or condenser.

Fig. 656.



Coil Plates.

a. Ring plate.
b. Hook plate.
c. Corner plate.
d. Rosette plate.
e. Movable-hook plate.
f. Wall plate.

Coil Stand. A pair of coil-plates (which see), arranged to stand upon a floor and to support the various coils or convolutions.

Coil Screen. An ornamental open-work of wire concealing a coil, but allowing passage of radiated heat through the openings.

Coil Steam Boil'er. One in which the water in coiled iron pipe is exposed to the heat of the furnace.

See Fig. 5636, Plate LXI., p. 2317, "*Mech. Dict.*"; also, Fig. 2686, p. 1191, *Ibid.*

A double coil steam generator was shown in Paris, 1878, by M. N. Roser, St. Denis (*Seine*).

Coin Al-loy'. An alloy for coins, prepared by Johnson, Matthey, & Co., of London, is

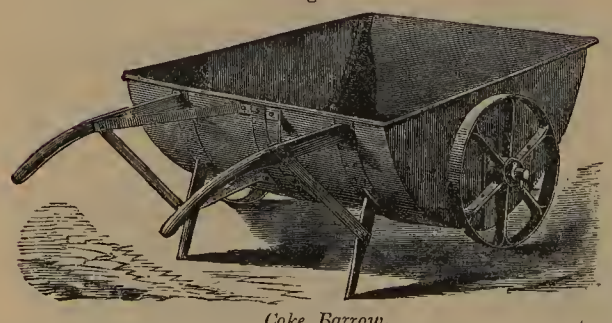
Aluminum	98
Nickel	2

It is light (Sp. gr. 2.75), does not tarnish; and is too light to be mistaken for silver. See also ALLOY, *supra.*

Detector, *Sutton* . * "*Manufacturer and Builder*," ix. 118.
Silver dollars . . "*Iron Age*," xxi., March 28, p. 7.
Tester, *Doherty* . * "*Scientific American*," xxxviii. 355.
Philadelphia mint . "*Scientific American Sup.*," 2892.
Apparatus . . . * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Monnaie*," vol. ii., ed. 1877.

Coke Bar'row. A large, semi-cylindrical

Fig. 657.



Coke Barrow.

sheet-iron two-wheeled barrow used about coke ovens and furnaces.

French . . . . . "*Scientific American*," * xxxix. 322.

Coke-con-sum'ing Bat'te-ry. (*Electricity.*) The coke is imbedded in melted nitrate of potassium or sodium; the former being burned at the expense of the oxygen of the latter. The negative electrode is cast-iron. Invented by *Jablochkoff.*

Niaudet, American translation . . . . . 240.
"*Scientific American Supplement*," . . . . . 1759.
"*English Mechanic*" . . . . . * xxvi. 109.

Coke Fork. A ten-tined fork for shoveling coke.

Coke Fur'nace. See the following references: —

Oven, *Aiken* . . . . . * "*Scientific Am. Sup*," 1026.
Carvé, Bessèges, Fr. . . . * "*Engineering*," xxix. 399.
Stove, article, "*Chauffage*" *Laboulaye's* "*Dict. des Arts*," etc., iv., Fig. 3458.
Self-coking, *Ferrie* . . . . "*Iron Age*," xix, May 24, 16
System, *Carve* . . . . . "*Iron Age*," xxii., Oct. 17, 11.
From anthracite dust, *Wister* "*Iron Age*," xxi., May 30, 9.
Crusher, *Thwaite & Carbutt* * "*Engineer*," xliii. 159.
Furnaces, Br. . . . . * "*Engineering*," xxiv. 227.
Self-coking, *Ferrie*, Ironton * "*Iron Age*," xvii., Feb. 3, 1.
Manufacture . . . . . * "*Sc. American*," xxxiv. 34.
Ovens, *Bennington* . . . . * "*Iron Age*," xxiii., June 26, 1
Oven, *Aitken* . . . . . * "*Iron Age*," xix., Jan. 11, 1.

See GAS AND COKE FURNACE, *infra.*

Cold Air Ma-chine'. See AIR REFRIGERATING MACHINE.

Also "*Scientific American Supplement*," 4011.

Cold'-i-ron Saw. A circular saw for removing the fag end of a rolled rail. It saws through a cold steel rail $5\frac{1}{2}''$ deep in 18 minutes.

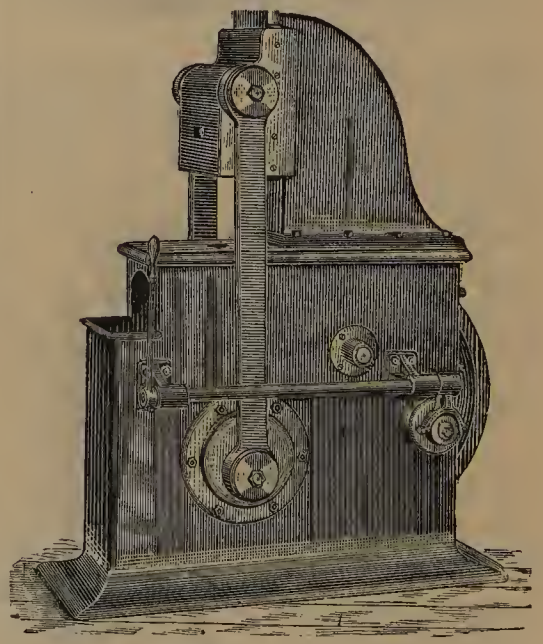
The cold saw used at the Landore Siemens Steel Co. is shown at Figs. 18, 19, p. 14, vol. xlii., "*Engineer.*"

Also used for cutting bar iron into lengths for piling, reheating, and re-rolling.

Sellig, Sonnenthal & Co., Br. * "*Engineer*," xlviii. 472.
For rails . . . . . * "*Engineering*," xxv. 382.

Cold-press'ing Ma-chine'. A machine for

Fig. 658.



Cold-pressing Machine.

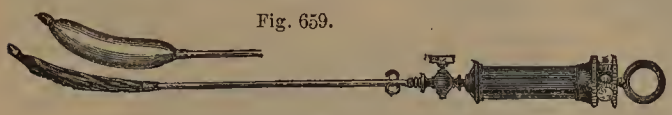
finishing by cold drawing, or for pressing forgings. It has a pressure of from 300,000 to 400,000 lbs.; stroke $1''$ to $6''$. It stops and starts instantly by means of Pratt's friction clutch.

Cold Shot. (*Foundry.*) Small globules of iron found in chilled portions of a casting.

Cold Shut. (*Add.*) 2. (*Founding.*) An imperfection in a casting owing to the cooling of the metal while flowing.

Cold Sound. (*Surgical.*) *Psychrophor.* Invention of Dr. Winternitz, of Vienna. An instrument for treating pollutions, spermatorrhea, and chronic gonorrhea.

Fig. 659.



Cold Sound.

A double current catheter without eyes, the two canals communicating near the point of the instrument. It is introduced into the urethra until its point has passed the *pars prostatica*, and it is then attached by rubber tubing to a reservoir containing water of the desired temperature. On turning the stop-cock, the water flows into one canal and out through the other. In this way the *caput gallinaginis* and the entire mucous membrane are exposed to the mechanical action of pressure and the sedative action of cold.

See also Fig. 56, Sup., *Tiemann's "Armam. Chirurgicum."*

Co-li-fi-ché. (*Ceramics.*) A little prism or tripod of refractory clay, used in a faïence or porcelain kiln to support the enameled or decorated ware in the second firing. They are known as *stilts* and *spurs* in England. See SEGGAR, Figs. 4815–4816, p. 2089, *"Mech. Dict."* where rings, ridges, and studs are shown supporting the ware in the seggars.

Col-lap'si-ble Boat. One capable of folding for convenient transportation.

Crispin's . . . * "*Scientific American*," xxxviii. 343.
Berthon's, Br. . * "*Scientific American Supplement*," 1327.
* "*Engineer*," xlviii. 162.
* "*Van Nostrand's Mag.*," xix. 94.
Osgood . . . * "*Scientific American*," xl. 38.
"*Iron Age*," xx., July 19, p. 1.

See also BOAT; FOLDING BOAT.

Col'lar. (*Nautical.*) 1. A bite at the end of a shroud or stay, to go over the mast-head.

2. A rope formed into a wreath, with a dead-eye in the bight, to which the lower part of the stay is secured.

3. The neck of a bolt.

4. A circular enlargement on a rod.

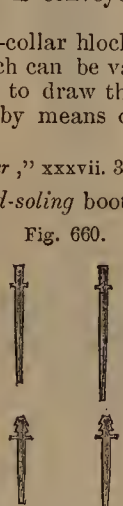
Col'lar-laun'der. The pipe or gutter at the top of a lift of pumps by which water is conveyed to the cistern.

Col'lar Ma-chine'. Vapey's horse-collar blocking machine consists of a former, which can be varied in length, and a tightener rope to draw the leather close to the former or mold by means of lever and screw.

Collar stuffing machine, *Lichliter* * "*Sc. Amer*," xxxvii. 38.

Col'lar Nail. A nail used in *blind-soling* boots and shoes. *Field & Sons.*

Fig. 660.



Collar Nail.

The nail being driven into the heel (or sole) as far as the collar, the outer lift (or sole) is driven on to the projecting pin, and thereby held, without the head of the nail appearing upon the outer surface.

Col'lar Swage. (*Blacksmithing.*) A swage set in the hardy hole of an anvil and used in swaging a collar on to a rod. The depression in the swage is equal to one half the size of the rod and collar; a top tool laid upon the iron completes the form, the piece being swaged between the two by the blows of a hammer. See also FULLER, SWAGE, etc. See Fig. 661.

Col-lo'dion. Gun-cotton dissolved in ether or chloroform.

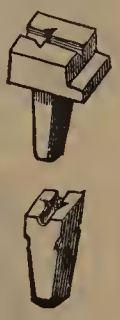
It is used for many purposes. See PYROXYLINE, p. 1831, *"Mech. Dict."*; GUN COTTON, p. 1036, *Ibid.*

See also CELLULOID, *supra.*

Col'lo-type. (*Photography.*) A name given to the process in which the image is taken upon a sensitive colloid film.

The first attempts were made on metallic plates, and the adhesion of the film was effected by the oxydation of the metallic surface. Albert introduced the use of glass plates, Obernetter used very thin zinc plates. Description of his process in *"Photographisches Wochenblatt."* Reproduced in *"Scientific American Supplement,"* 2671.

Fig. 661.



Collar Swage.

Col'o-phene. A viscid colorless oil, obtained by distilling oil of turpentine with sulphuric acid. See Clarke's Patent, No. 6,001, June 2, 1849.

Col'or Com-par'a-tor. An apparatus by Dr. Leeds, of the Stevens Institute, for making comparisons of tints of color.

A rack holds ten comparison tubes of equal caliber and contents. An adjustable mirror reflects the light downward through these comparison tubes, and the light, after passing through slits (¾″ long and ¼″ wide), cut in a stage beneath, is reflected outward to the eye by a similar adjustable mirror placed below. In the original apparatus, the supports of the upper mirror are placed at the front corners, so as to make the axis of the mirror in front of the upper row of holes, and permit the tubes to be lowered into their places from the top. Later, it was found more convenient to slip the tubes in from below, which can be done without rising from one's seat, and in this case the axis of the mirror was put directly over the centers of the line of holes, and the mirror made somewhat narrower (3″). A black cloth, hung from the back upper corners, prevents any light reaching the eye except that reflected from the lower mirror.

The comparison is effected by a prism nearly filled with a suitable colored liquid. The prism is constructed by cementing within four straight walls of plate glass the inclined top and bottom sides of the prism. It is 10″ long, 1½″ wide, 2¾″ at the base of the prism, narrowing to 3-16″ at the apex. The prism is cut off in this manner at the apex, because, when filled with liquid of the most suitable intensity of color, the graduations beyond this point are too inconsiderable to be of value. The liquid is introduced through an orifice in the base, over which is afterward cemented a glass cover.

"*Scientific American Supplement*" . . . . * 2135.

Col'ored Glass. (*Glass.*) Glass colored in the pot; as distinguished from *enameled*, which has a surface of vitrifiable color baked on.

It consists commonly of two layers, white and colored melted into junction, or one laid upon the other: in some instances, white glass overlaid with three or four colors. There are, however, other modes. See list under GLASS, *"Mech. Dict.," et infra.*

The oxides of the different metals form the colors: —

For blues: oxide of cobalt or *safre*, oxide of iron, etc.

Shades of blue, such as *violet* or *celestial:* different proportions of cobalt.

Light blue, for spectacles: a mixture of cobalt and red oxide of iron.

London smoke: a mixture of oxides of copper, iron, and manganese.

Black: by increasing proportions of the last mentioned.

Purple: oxide of manganese. Potash glass with manganese gives a bluish purple; soda glass verges on the red. The color is made of a deeper blue by the addition of cobalt.

Brown purple: a mixture of oxides of manganese and iron.

Ancient purple: a mixture of oxide of manganese and red oxide of iron.

Yellow: a mixture of oxides of iron and manganese; charcoal is supplied in the shape of wood sawdust, an increase of which gives an orange, or in excess red.

A mixture of ochre and silver applied to the surface and baked in.

Green: a mixture of black oxide of copper and oxide of iron: or replace a part of these oxides by one third of their weight of bi-chromate of potassium.

Blue green: add oxide of cobalt to the above.

Yellow green: add yellow oxide of uranium to the recipe for green.

Red or *ruby:* brown oxide of copper, oxides of lead and

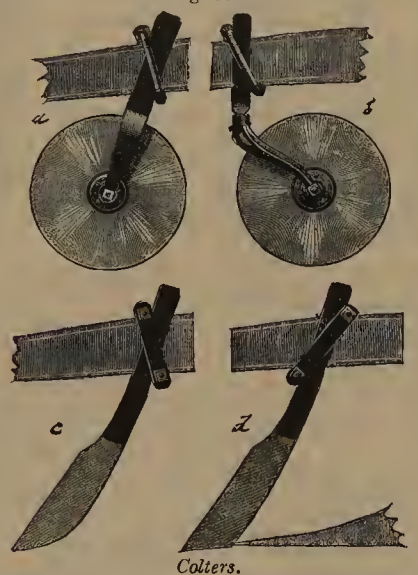
tin, scales of iron, and borax, are added to the batch in the pot and melted. The glass is dipped out, broken or ground, and remelted, with additional quantities of the oxides and borax. The color is not developed until repeated heatings.

Opal: calcined bones are added to the batch of glass in the pot. Cryolite, 10; white sand, 20; oxide of zinc, 20; make an opal glass, called *Hot cast porcelain.* See also CRYOLITE.

Fluor spar added to the batch.

Laboulaye's "*Dictionnaire des Arts et Manufactures,*" Article "*Verre.*"
"*Scientific American*" . . . . . xxxiv. 263.
"*Scientific American Supplement*" . . . 129.

Fig. 662.



Colters.

a. Rolling colter. *c.* Knife colter.
b. Caster colter. *d.* Standing colter.

Col-o-rim'e-ter. Dr. Scheibler's method consists in a number of parallel tubes in which solutions of sugar and syrups are examined for relative depths and qualities of color.

Nanquette, "*Technologiste,*" xl. 362.
See also DIAPHONOMETER, *infra.*

Col'or-ing Met'als. Prepare a solution of sulphide of lead by dissolving ½ oz. of hyposulphite of sodium in 1 lb. of water, and adding ½ oz. of acetate of lead dissolved in 8 oz. of water. Heat to 200° Fah., and the sulphide of lead is precipitated in brown flakes.

Metals exposed to the solution become colored —

Brass in the following order, according to the time of exposure, and consequent thickness of the coat: gold, copper-red, carmine, dark red, blue, blue-white, reddish white.

Iron becomes steel blue.

Zinc becomes brown.

Copper, the order of brass, except that the gold color does not appear.

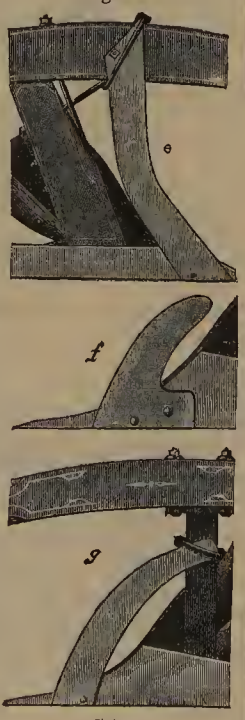
If, instead of the acetate of lead, sulphuric acid be added to the hyposulphite of sodium, the brass becomes red, green, brown, with green and red iris glitter.

See also BRONZING, etc

Col-peu-ryn'ter. (*Surgical.*) An inflatable bag introduced into the vagina to prevent prolapsus uteri.

Braun's, Fig 420, p. 90, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Fig. 663.



Colters.

e. Quincy cutter.
f. Fin cutter.
g. Sword cutter.

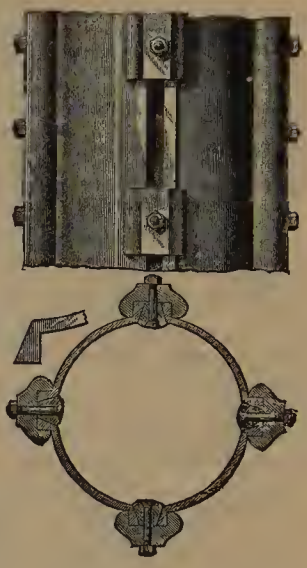
Col'ter. The sward cutter in advance of the plowshare and mold-board. See Figs. 662, 663.

Rotary colter grinder . * "*Scientific American,*" xlii. 198.

Co-lum'bin. (*Electricity.*) The non-conducting material placed between the parallel carbons of the ELECTRIC CANDLE, which see.

Col'umn. Built wrought iron columns, so much used in modern engineering, are made in segments, which are bolted together. The construction of two prominent forms is evident at a glance. Figs. 664, 665.

Fig. 664.



Built Iron Column.

Col'umn Bat'te-ry. (*Electricity.*) One in which the elements are formed into a column. See VOLTAIC PILE.

Comb. (*Add.*) 8. (*Fire-arms.*) The top corner of the stock, where the cheek rests in firing.

Comb making, * "*Manufacturer and Builder,*" x. 129.

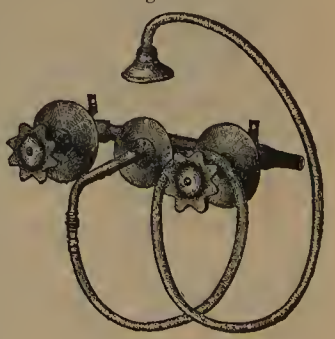
Com'bi-na'tion Au'ger. An auger used in well or shaft boring. It has a long barrel, inclined throats at the lower end, and detachable horizontal cutters. Used in clay, sand, and other soft or friable strata.

Fig. 665.

Phœnix Iron Co.'s Wrought-iron Column.

Com'bi-na'tion Ba'sin Cock. A shampooing arrangement in which the tube and sprinkler connect with hot and cold water faucets, so as to receive a mingled stream of the required warmth.

Fig. 666.



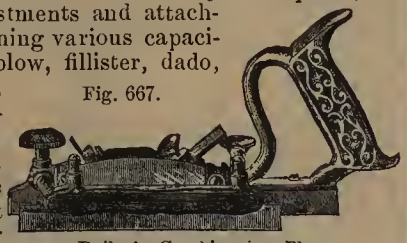
Combination Cock.

Com'bi-na'tion Lock. 1. A bank or safe lock, the mechanism of which is operated by two graduated dials, whereby one bolt, common to both, is controlled by either of the two independent dials, which latter may be set on two different combinations, thus giving the control to either of two persons.

2. A *permutation* lock: see Figs. 3646–3648, p. 1669, "*Mech. Dict.*"

Com'bi-na'tion Plane. A joiner's plane, capable, by adjustments and attachments, of assuming various capacities: such as plow, fillister, dado, rabbet-plane, matching-plane, etc.

Fig. 667.



Bailey's Combination Plane.

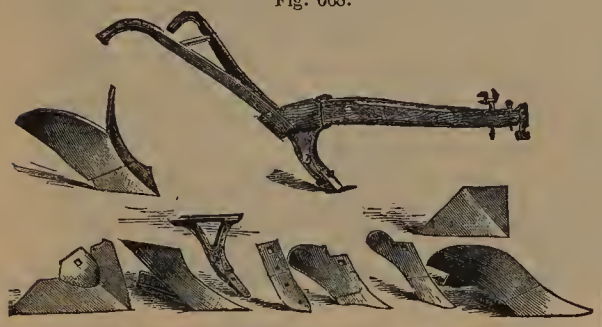
The main feature of the plane is that it has a fence or guide which is made to change to one side or the other, as the nature of the work requires, the fence being also vertically adjustable.

Com'bi-na'tion Plow. A plow having a number of optional shares, so as to be convertible to a number of different uses.

Combination plows are generally those of the smaller class, such as are used in tending crops, rather than those for breaking ground; many are found in the varieties adopted for special culture, such as beets, grapes and garden crops.

Hornsby's (English) plow has a number of mold boards; also potato diggers, hoe frames, etc., either of which can be attached to the beam.

Fig. 668.

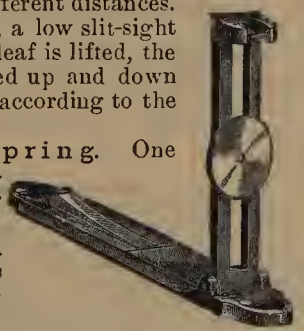


Combination Plow.

Farquhar's convertible plow, Fig. 668, has double shovel, single shovel, subsoil, bull-tongue, ridging shares and bodies.

Com'bi-na'tion Open and Peep Sights. A species of gun-sight, Fig. 669, having several sights for different distances. When the leaf is down, a low slit-sight is exposed. When the leaf is lifted, the peep sight may be slipped up and down on the graduated stem, according to the distance of the object.

Fig. 669.



Combination Open Peep Sight.

Com'bi-na'tion Spring. One made by the multiplication of several similar parts.

In elliptic springs for railways see numerous examples in Fig. 1144, p. 483, "*Mech. Dict.*"

Instances of the spiral kind in Fig. 1148, same page.

Combinations of steel and caoutchouc: Figs. 1142–1144, pp. 482, 483, *Ibid.*

Com'bi-na'tion Scale. A scale with several beams.

a. A dairy scale beam which admits of weighing the milk brought by a number of farmers, at the same draft, keeping the weight of each on its own beam. See CREAMERY SCALE.

b. A postal-scale having separate beams and poises, the graduations in grams and ounces (and fractions) on each respectively.

c. A weighing scale with one beam for the cart, and another for the load; with the addition of a third beam for small weights, the second being for the thousands.

d. A furnace scale for charging the barrow with the respective quantities of ore, coke, and limestone, to be dumped into the hopper of the blast furnace. See FURNACE CHARGER.

"*Engineering and Mining Journal*" . . . * xxvi. 313.

Com-bined' Car. (*Railway.*) One with separate compartments for different purposes, as a *combined baggage and express car*, or a *combined mail and passenger car*, etc.

Or: one capable of being converted to distinct uses; as a *combined box and cattle car.*

Comb'ing Ma-chine'. The cotton combing machine of *Heilmann*, of Alsace, is a marvel of ingenuity in preparing cotton for fine counts of yarn. The machine has been somewhat simplified by Dobson & Barlow, of Bolton, England. The action is intermittent, by means of nippers and combs. In the Dobson & Barlow machine the nipper holds the cotton to be combed against the fluted feed rollers. The cotton is drawn up into the top comb by the detaching rollers, which draw it in a straight line from the grip of the two feed rollers.

Some of the following references concern flax, and other cotton: —

Laboulaye's "Dictionnaire des Arts et Manufactures."

Girard, French . . . . * ii., art. "*Lin*," Figs. 1424–1429.
Worstworth, Engl. . . . * ii., Figs. 1430, 1431.
Fairbairn, Engl. . . . * ii., Figs. 1432, 1433.
Westley & Lawson, Engl. * ii., Figs. 1450–1452.
Heilmann . . . . . * iv., art. "*Peigneuse.*"
* ii., art. "*Laines.*"

Linen, *Horner* . . . . . * "*Technologiste*," xxxvii. 24.
Ward . . . . . * "*Technologiste*," xxxvii. 27.
Stephen, Cotton & Co. * "*Technologiste*," xxxvii. 30.
Combe & Barbour . . * "*Technologiste*," xxxvii. 41.
Vanoutryve . . . . "*Technologiste*," xxxvii. 215.
Heilmann, Lille . . . . * "*Scientific Amer. Sup.*," 3896.
Pierrard . . . . . * "*Scientific Amer. Sup.*," 2581.

Com'fit Pan. For making comfits and all kinds of confections known as pan goods. The pan is heated by steam conveyed through an india-rubber tube. Another tube conveys away water of condensation. It does not revolve, but has a peculiar rocking motion. See CONFECTION PAN.

Com'mu-ta'tor. (*Electricity.*) An instrument or arrangement used to change the currents from primary to secondary, or the reverse; to change the polarity of a current; or to change from one to more cells in a constant battery.

Mercury, *Lartigue* . "*Telegraphic Journal*," vii. 153.

Com-par'a-tor. *a.* An instrument for comparing measures of length together. The objects to be compared are laid on an iron bed, and microscopes with micrometric eye-pieces placed vertically over the bed for observation and comparison.

In the comparator of *M. Tresca* but one microscope is used; the bars to be measured are placed side by side upon the bed, which is movable both laterally and longitudinally. One end of the standard is first brought under the microscope, and afterward, the corresponding end of the scale to be tested is by a lateral movement similarly brought into the field of view, and by the slow movement of the scale itself, if necessary, its terminal mark is brought into coincidence with the cross-wires of the microscope. The whole system is then moved longitudinally until the opposite ends of the bars come under observation, when without disturbing the microscope the mark on the standard rule is first brought into coincidence with its cross-lines, and subsequently that on the rule to be tested, the difference in length, if any, between the two being measured by the micrometer.

b. Saxton's comparator consists essentially of a mirror, which reflects a beam of light over double the angle through which the mirror is revolved, and this beam acts as an index by being caused to sweep over a graduated scale, having for its center the center of the axis of the mirror. It will be obvious how measurements may be made by this arrangement. It is applied by Prof. A. F. Mayer to the observation

and measurement of the changes in the dimensions of iron and steel bars on their magnetization.

See "*Scientific American Supplement*," *1519, *1595, *1637, *1694.

c. Lissajous' comparator "consists of a diapason, to one limb of which is attached the object-glass of a compound microscope: the body of the microscope being detached and supported by an independent stand. If the diapason be thrown into vibration, the image of any small object seen through the microscope will appear to have a similar motion, which will be magnified by all the power of the instrument. Let the object be itself a point in a vibrating body, having its direction of vibration at right angles to that of the object-glass, and the combination of the two motions will produce figures, from the analysis of which the character of the vibration of the body observed may be deduced. When the vibrating body is a string, or other object without conspicuous points suited to be used in the comparison, it is necessary to mark it in some manner. Different observers have adopted different expedients for this purpose; but in order to avoid loading the body or altering its condition by adding coloring matters, Mr. Lissajous, in the case of strings, has employed a cylindrical lens to throw a sharp line of light across the object. This creates a brilliant point moving with the string without in any manner disturbing its mode of vibration." — *Dr. F. A. P. Barnard*, "*Paris Exposition Reports*," * iii. 508, 509.

See also ELECTRICAL DIAPASON.

Com'pass. See list under COMPASS, p. 599, "*Mech. Dict.*"

Alarm	"*Scientific American*," xli. 81.
Correction, *Thompson* .	"*Scientific Amer. Sup.*," 760.
Differential, *Ile*	"*Scientific Amer. Sup.*," 255.
Japanese	"*Scientific American*," xxxv. 67.
Nickel needle, Fr. . . .	"*Telegraphic Journal*," iv. 75.
Sir William Thompson .	"*Scientific Amer. Sup.*," 568.

See also AZIMUTH, etc.

Com-pen'sa-tor. (*Gas.*) An aid to the governor of the gas-exhauster engine, in order to maintain equal pressure in the main when the exhauster may be working in excess of the production of gas. The object is to limit the vacuum, to prevent its reaching a dangerous degree. The raising of a bell in the compensator opens a valve in the bye-pass, and allows the gas to pass around the exhauster ineffectively. See GAS COMPENSATOR; GAS GOVERNOR.

Com-pos'ing Ma-chine'. *Flamm's* (French) and *Sweet's* (American) machines, acting by the consecutive impressions of types upon cliches, which form molds for stereotyping. Described in article "*Imprimerie*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Frazer's composing machine was shown in operation at the Paris Exposition, 1878.

See TYPE-SETTING MACHINE, p. 2675, "*Mech. Dict.*"

Com'po-si'tions, Wa'ter-proof'ing, etc. See the following: —

Amber.	Eburine.
Amber, artificial.	Eburite.
Asbestos.	Felt.
Asbestos felt.	Fire-proofing.
Balcen.	Fire-proofing cloth.
Beeswax, artificial.	Fire-proofing fabrics
Black lead.	Fire-proofing paper.
Bois durci.	Fire-proofing wood.
Bolata gum.	Fly paper.
Boncsilate.	Gas and water-tight cloth.
Boulinikon.	Gas cloth.
Caoutchouc.	Grafting wax.
Caoutchouc, artificial.	Graphite.
Caoutchouc solvents.	Hemacite.
Carbolic-acid paper.	Hevcenoid.
Cartonpierre.	Incombustible wood.
Celluloid.	India rubber.
Cellulose.	Ivorine minerale.
Ceresin.	Ivory, artificial.
Chrome leather.	Kerite.
Coral, artificial.	Leather, artificial.
Cork board.	Leather, imitation.
Cork leather.	Leatheroid.
Corundum.	Leather waste.
Cosina.	Lining felt.
Ebonite.	Meerschaum.
Ebony, artificial.	Meerschaum, artificial.
Metaline.	Soluble glass.
Metallikon.	Spence's metal.
Mica.	Straw-wood.
Mineral wool.	Sulphurine.
Oil cloth.	Sulphur-sulphide.
Paper carpet.	Tar.
Paper fabric.	Thiate.
Paper preservative.	Tripoli.
Paper, fire-proofing.	Usudurian.
Papier-maché.	Vegetable leather.
Parakite.	Vegetable tallow.
Pastille.	Vegetaline.
Pâte de bois.	Veneer, celluloid.
Plumbago.	Vulcanite.
Rubber solvent.	Vulcanized fiber.
Shoemaker's wax.	Water-proofing.
Silicate board.	Water-proofing fabric.
Silicate cotton.	Water-proofing paper.
Slag.	Wax.
Slag cloth.	Whalebone.
Slag wool.	Wooden wall-covering.

Com-pos'ite Por'trait. One obtained by combining a number of portraits into a single resultant figure.

See paper read by Francis Galton, F. R. S., before the Anthropological Institute, London.

Partly reproduced in "*Scientific American*," xxxviii. 389.

Com-pos'i-to. (*Ship-building.*) A *composite* vessel is one built partly of iron and partly of wood: *e. g.*, some of the U. S. Coast Survey vessels which have hulls, the frames and beams of which are of iron and the planking of wood.

See *Wilson's* "*Ship-building*," Wiley & Sons, New York.

Com'pound Ar'mor. An iron plate with steel facing. See ARMOR COMPOUND; also ARMOR PLATING, "*Mech. Dict.*"

Com'pound Cot'ton Press. One in which a hydraulic ram of relatively small area and rapid movement is used to compress the cotton up to a certain point, and then a relatively larger and more powerful, slow-moving ram is used to complete the pressure.

Watson . . . . . "*Engineer*," *xlv. 38, 46.

Com'pound Beam En'gine. A beam engine, with compound cylinders, in which the steam is used successively at a higher and then lower pressure.

See in list of references under COMPOUND STEAM ENGINE.

Com'pound En'gine. See COMPOUND STEAM ENGINE.

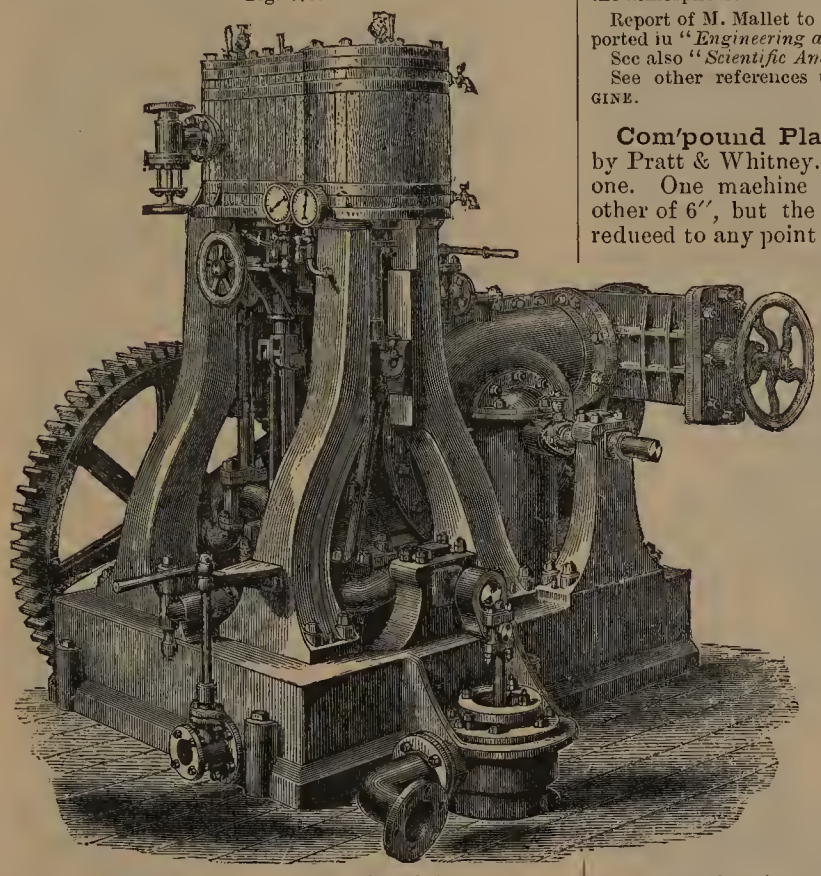
Com'pound En'gine Pump. Appleby's compound engine applied to the centrifugal pump is shown in Fig. 670, and is used in Egypt, where it forms a remarkable contrast to the norias, shadûfs, etc.

The whole arrangement is self contained, all the various parts being attached to one deep massive cast-iron bed-plate, which carries the crankshaft pedestals and the pedestals for the pump spindle. The engines are of the vertical type, compound and condensing. The high pressure cylinder is 7″ diameter, and the low pressure cylinder 14″ diameter, so that the areas are in the proportion of 1 to 4, and each has a piston stroke of 14″. The valve boxes are between the cylinders, a cover being provided at the top for examination, etc., and the cylinders and valve boxes are felted, and lagged with mahogany. The valve of the low pressure cylinder is the ordinary D valve, but the high pressure engine is fitted with a Mayer's expansion gear, whereby the expenditure of steam can be regulated in accordance with the height to which the water has to be pumped. Each of the cylinders is mounted on, and cast with a pair of strong iron standards, which also form the guides for the cross-head, a portion of them being bored for this purpose.

The jet system of condensation is used, the condensing chamber being formed in the bed-plate. The cock for regulating the supply of injection water and the air pump are in the foreground of the engraving, the latter of the ram and bucket principle, is driven by a crank arm and pin on the end of the crankshaft, the valves being india-rubber disks working on gun-metal gratings. A spur fly-wheel is keyed on to the end of the crankshaft, this drives a pinion on the

pump spiudle, so that the pump disk makes three revolutions for each double stroke of the engines; this enables the engines to maiutain a very moderate speed, aud obviates the necessity of the constant repairs, which frequently are a

Fig. 670.



Compound Engine and Centrifugal Pump.

source of inconvenience in very high speeded engines. The pump has 12″ suctiou and delivery pipes, the suction pipe having a foot valve on it, and the delivery being provided with a sluice valve. The pump disk makes about 600 revolutious per minute, and delivers 2,500 gallons per minute to a height of 20′. Small covers are provided on each side of the pump casing, so that the disk may be examined without taking the pump to pieces.

See also references under COMPOUND STEAM ENGINE.

Com'pound Lathe. The *tour composé* of the Freneh. The term may be held to inelude the geometric, rose engine, oval, and engine-turning lathes. Whieh see.

See elaborate article, *cap.* "*Tours Composés*," *Laboulaye's* "*Dictionnaire*," etc., iv., ed. 1877.

Com'pound Lo'co-mo'tive. One using the steam in two sueeessive eylinders.

The compound locomotive has but two eylinders; they are placed on the outside, and act at right angles to each other, as in ordinary locomotives with outside eylinders, the only difference being that the eylinders have different diameters, and that the smaller one alone, in the regular working of the engine, receives the boiler steam directly, discharging it after a first expansion into the larger one, which in turn discharges it into the chimney.

When the engine is to be started, the boiler steam, by means of a special apparatus, which constitutes the sole addition to the ordinary locomotive, and which from its design and purpose is called the *undoing* valve, is delivered directly into both the large and small eylinders, and the latter, instead of discharging it into the former, discharges it into the chimney, the engine in this case acting like an ordinary locomotive. This independent action of the steam in the two eylinders can also be employed when the engine has to overcome a momentarily greater resistance, like a short steep ascent, for instance.

The system just described has been for the first time applied by M. A. Mallet to three locomotives, constructed at Creuzot, for the branch railroad from Bayonne to Biarritz. They weigh in service from 19 to 20 tons each, and have eylinders of 9 7-16ths and $15\frac{3}{4}$″ diameter, with pistons of $17\frac{3}{4}$″ stroke. They have four coupled wheels of $47\frac{1}{4}$″ diameter. The boiler has 484.4 square feet of heating surface, and is worked with a pressure of 142 pounds per square inch above the atmosphere.

Report of M. Mallet to "*French Academy of Sciences*," reported in "*Engineering and Mining Journal*"

See also "*Scientific American*," xxxvii. 260.

See other references under list in COMPOUND STEAM ENGINE.

Com'pound Pla'ner. A machine tool made by Pratt & Whitney. It combines two planers in one. One machine has a stroke of 10″, and the other of 6″, but the length of the stroke may be reduced to any point below these limits. The tool-slide has a quiek return stroke, and the cross-feed is automatic and adjustable.

Com'pound Plate Bat'te-ry. One, the negative plate of whieh, instead of being of one material, is eonstrueted of several different metals soldered together.

Byrne's "*Engineering*," * xxv. 421.

Com'pound Spec'ta-cles. 1. *a.* One in which supplementary frames of eolored glass are hinged to the ordinary speetaeles, for use upon oeeasion.

b. The same adaptation of additional lenses to increase the power.

2. The Franklin speetaeles of two half glasses of different eharaeter in eaeh bow.

Chevalier in "*Sc. Am. Sup.*," * 2264.

Com'pound Spring. A spring in whieh several different types of springs are united to produce a simple effeet.

Speeifically: a steel spring surrounding or eonfining a eylinder or block of eaoutehoue.

See instanees in Figs. 1142, 1143, 1144, pp. 482, 483, "*Mech. Dict.*"

A *combination* spring may be defined as one in whieh several similar parts are multiplied to inerease the resisting power.

Com'pound Steam Boil'er. One eonsisting of several separated but eommunieating ehambers, usually having some different funetions; for instanee, boiler and superheater, or sectional portion with elevated ehamber, ete.

German forms: —

Steinmüller	"*Engineer*," June 11 1880.
Pregardien	"*Engineer*," 1. 228.
Piedbœuf	"*Engineer*," 1. 228.

See several examples, Plate LXI., p. 2327, "*Mech. Dict.*"

Com'pound Steam En'gine. An engine using the same steam sueeessively in two eylinders at diminishing pressures.

The *Hornblower* engine, mentioned on page 601, "*Mech. Dict.*," dates from 1781. The *Heslop* engine, patented by him in England in 1790, has lately attracted a good deal of attention. Nine of these engines were built, and one remains, being preserved in the South Kensington Museum, London.

"The Heslop engine has two open-topped eylinders, called respectively the hot and cold eylinder, one on each side of the main center of the beam; both are single acting, their pistons acting in the same direction. The steam, on being admitted into the first or hot eylinder, helps to raise the piston by its pressure underneath; the return stroke is then made by the weight of the pump-rods, etc., in the pit, sus-

pended by a chain working over an arched beam-head. During the down-stroke of the pump-rods, the reduction valve being opened, the steam passes from the hot cylinder to the second or cold cylinder by means of a connecting pipe constantly immersed in cold water, which produces sufficient condensation to *kill* or reduce it to atmospheric pressure as it enters and fills the cold cylinder. The cold piston having arrived at the top of its stroke and its cylinder being thus filled with steam, the injection valve is opened, admitting a jet of water beneath the piston, thus bringing a vacuum into play. In the case of rotative engines, the return stroke is made by the weight of the connecting-rod, crank, and a heavy pair of links attaching the hot piston to the beam, assisted by the momentum of the fly-wheel. The two pistons are heavily weighted in equilibrium, probably to keep the chains taut, and the action of the steam in the hot cylinder simply takes off the weight of the hot piston, and allows that of the cold piston to come into play."

See the following notices by adaptors or of adaptations of the compound principle: —

Borsig, Ger. . . . . * "*Iron Age*," xxv., Feb. 26, p. 1.
Burgh, Br. . . . . * "*Engineering*," xxiv. 471.
Demenje, Fr. . . . . * "*Technologiste*," xli. 267.
* "*Sc. American*," xl. 66.
Donkin, Br. . . . . "*Engineering*," xxi. 212.
Goodfellow (wire rope gear), Br. * "*Eng'ing*," xxiii. 381.
* "*Sc. Am. Sup.*," 1268.
Locoge, Fr. . . . . * "*Technologiste*," xli. 628.
Pearson & Spurr, Br. . . . . * "*Sc. Am. Sup.*," 2032.
S. S. "City of Rome," Inman . * "*Sc. Amer. Sup.*," 3946.
S. S. "Nelson," Br. Navy . . . * "*Sc. Amer. Sup.*," 3767.
Trials of, 19 Figs., Br . . . . * "*Engineering*," xxx. 311.
Urquhart, Hor. . . . . * "*Sc. Amer. Sup.*," 1920.
U. S. Navy, Trials . . . . . "*Engineering*," xxiii. 381.
Watt . . . . . * "*Sc. Am. Sup.*," 2844.
Westphal, Ger. . . . . * "*Technologiste*," xli. 320.
Yacht "Isa," Br. . . . . * "*Sc. American*," xl. 238.

Also — arranged by character of engine: —

Beam . . . . . * "*Sc. Amer.*," xxxiv. 7.
Corliss . . . . . * "*Engineer*," xliii. 62
Powell, Fr. . . . . * "*Engineer*," xlvi. 1.
Blowing, *Klein*, Ger. . . . . * "*Engineering*," xxx. 372.
Wetter-on-the-Ruhr . . . * "*Engineering*," xxix. 170, 175.
Condensing, *Claparede*, Fr. . . * "*Engineer*," xlvii. 120, 135.
Day & Co., dir. act., Br. . * "*Engineer*," xlv. 465.
Galloway, expanding, Br. . * "*Engineer*," xlvi. 226, 240.
Gutehofnung Schütte . . . * "*Engineering*," xxx. 88.
S. S. "Limerick," incl., Br. * "*Engineer*," xliv. 43, 61.
S. S. "Nipsie," U. S. Navy . "*Sc. Amer. Sup.*," 656.
Sulzer, exp., Switz. . . . * "*Engineer*," xlvi. 147.
See also Horizontal Condensing.
Corliss, Douglas & Grant, Br. . * "*Sc. Amer. Sup.*," 1023.
beam . . . . . * "*Engineer*," xliii. 62.
horizontal, Br. . . . . * "*Eng'ing*," xxviii. 487.
Pawtucket . . . . . * "*Engineering*," xxviii 154, 189.
Direct acting, *Henderson* . . . "*U. S. Patent*," Dec. 24, 1869.
Disconnecting, Br. . . . * "*Sc. Amer. Sup.*," 3799.
Factory, *Bates & Co.*, Br. . . . * "*Engineer*," xlviii. 379.
Ferryboat, "Loftus Perkins," Br. * "*Engineer*," xlix. 3.
Horizontal, *Alsaciennes Soc.*, Fr. * "*Engineering*," xxv. 4.
Avonside Engine Co., Br. . * "*Engineer*," xliv. 242.
* "*Sc. Amer.*," xxxvii. 370.
Brearley, Br. . . . . * "*Engineer*," xlv. 238, 258.
Herman-Lachapelle, cond. . * "*Technologiste*," xli. 89.
Holborow, Br. . . . . * "*Engineering*," xxv. 386.
Stribo mines, cond., Bohem. * "*Engineering*," xxx. 169.
Sulzer, condensing, Switz. . "*Engineering*," xxvi. 133.
Turnbull, condensing, Br. . * "*Engineer*," l. 214.
* "*Engineering*," xxv. 202.
Urquhart . . . . . * "*Sc. Amer. Sup.*," 1920.
Launch, exp., *Kingdon*, Br. . . * "*Sc. Amer. Sup.*," 3848.
Tipping, Br. . . . . * "*Engineering*," xxx. 229.
Tipping, Br. . . . . * "*Engineer*," l. 140, 156.
Wilson, exp., Br. . . . . * "*Engineer*," xliii. 24
Locomotive, 21 Figs. . . . . * "*Engineer*," xlviii. 85.
Fr. . . . . "*Van Nostrand's Mag.*," xv. 379.
Mallet, Fr. . . . . "*Technologiste*," xxxvii. 114.
Mallet, Fr. . . . . * "*Eng'ing*," xxviii. 17, 58.
Mallet, Fr. . . . . "*Iron Age*," xxiv., Aug. 7, p. 15.
Mallet, Fr. . . . . "*Van Nostrand's Mag.*," xxii. 6; xxiii. 418.
"*Sc. Amer.*," xxxvii. 260.
Marine, *Claparéde*, Fr. . . . . * "*Engineer*," xlvi. 385, 388.
Cramp . . . . . * "*Engineering*," xxii. 298.
Escher, Wyss & Co., Switz. . * "*Engineering*," xxx. 345.
Marine, *Sells*, Br. . . . . * "*Engineer*," xlii. 272.
Sells, Br. . . . . * "*Sc. Amer.*," xxxvi. 166.
Vile, Br. . . . . * "*Engineer*," xlviii. 162.
S. S. "Arizona," Br. . . . * "*Engineering*," xxx. 28, 89, 132.
"Britannic," . . . . . * "*Sc. Amer. Sup.*," 806.
"City of New York," Br. * "*Engineer*," xliv. 458.
"City of New York," Br. * "*Engineer*," xlv. 4, 26.
"City of Rome," Br. . . * "*Engineer*," xlv. 127.
* "*Sc. Amer. Sup.*," 3946.
"Dante," Br. . . . . * "*Eng'ing*," xxviii. 380.
"Grangemouth," Br. . . * "*Engineer*," xlv. 129, 132.
"Grangemouth," Br. . . * "*Sc. Amer.*," xxxviii. 259.
"Grecian," Br. . . . . * "*Engineering*," xxix. 400, 435, 475, 496.
"Isa," Yacht, Br. . . . * "*Sc. American*," xl. 238.
"Iris," Br. . . . . * "*Engineer*," xlv. 98.
"Limerick," Br. . . . * "*Engineer*," xliv. 43, 61.
"London Castle," Br. . . * "*Engineer*," xliii. 341.
"Lord of the Isles," Br. . * "*Engineer*," xlvii. 28, 46, 82, 98, 170.
"Mytho" . . . . . * "*Engineer*," xlviii. 288.
"Nelson," Br. Navy . . * "*Engineering*," xxix. 279.
* "*Sc. Amer. Sup.*," 3767.
"Nipsic," U. S. Navy . . "*Sc. Amer. Sup.*," 656.
"Ohio," "Penn.," *Cramp*. * "*Engineering*," xxii. 63.
"Orient" . . . . . * "*Engineer*," xlviii. 247.
"Rover," Br. . . . . * "*Engineer*," xli. 324.
* "*Engineering*," xxi. 228.
"Ville d'Oran," Fr. . . * "*Engineer*," l. 101, 214.
"Wanderer," Yacht . . * "*Engineer*," i. 440, 444.
steeple, "Lady Tyler," Br. . * "*Engineer*," l. 386, 424.
paddle, "Hirondelle," Fr. . * "*Engineer*," xli. 317–320.
inclined, *Soc. John Cockerill*, direct acting, Belg. * "*Engineering*," xxx. 320.
(See also SCREW.)
Portable, Br. . . . . "*Iron Age*," xxiv., July 31, 13.
Fowler, Br. . . . . * "*Technologiste*," xli. 498.
Garrett, Br. . . . . * "*Engineer*," l. 40, 44, 397.
* "*Engineering*," xxx. 44.
Marshall, Br. . . . . * "*Engineering*," xxx. 538.
Pumping, Chichester, Br. . . . * "*Engineer*," xlvi. 336.
Comstock . . . . . * "*Engineer*," xli. 187, 194.
differential, Croydon, Br. . * "*Engineer*," xliv. 338.
Dubuc, Fr. . . . . * "*Engineer*," xlv. 424.
Goodhope Co., Br. . . . . * "*Engineer*," xlv. 58.
Lawrence, beam . . . * "*Engineering*," xxix. 18.
Nijni-Novgorod, Rus. . . . * "*Engineering*," xxx. 341.
San Francisco . . . . * "*Engineer*," xlv. 198, 202.
Selden . . . . . * "*Man. & Builder*," ix. 80.
Staveley, horizontal, Br. . * "*Engineer*," l. 232, 262.
Sydney, Australia . . . * "*Engineering*," xxiv. 10.
Tangye, Br. . . . . * "*Engineer*," xlii. 128.
Vienna, Austria . . . . * "*Eng'ing*," xxviii. 432.
Rolling-mill, Br. . . . . * "*Engineer*," xlvii. 204.
Reversing, Br. . . . . * "*Engineering*," xxvii. 274, 277.
Phœnix Iron Co. . . . . * "*Engineering*," xxix. 105.
Screw, disconnecting Twin, *Lawrence*, Br. . . . . * "*Engineer*," xlvii. 405.
S. S. "Lord Jeffrey," Br. . * "*Engineering*," xxx. 517.
S. S. "Otter." . . . . * "*Sc. Am. Sup.*," 1345.
Discon. *Rankin & Blackmore* * "*Engineering*," xxiv. 9.
Ross & Duncan, Br. . . . * "*Engineering*," xxix. 337.
Soc. John Cockerill, Belg. . * "*Engineering*," xxx. 402.
U. S. Navy . . . . . * "*Engineering*," xxii. 150, 206, 276, 439; * xxiii. 110, 129.
Semi-portable, *Fowler*, Br. . . * "*Engineer*," xlvii. 452.
Single cylinder, *Westphal.*, Ger. * "*Engineering*," xxvi. 510.
Street-car, *Black, Hawthorn & Co.* * "*Eng'ing*," xxviii. 363.
Three cylinder . . . . . * "*Engineering*," xxi. 191.
Brotherhood . . . . . * "*Iron Age*," xxii., Aug. 8, p. 1.
* "*Sc. Am. Sup*," 2194.
* "*Engineering*," xxvi. 9.
Yacht "Isa," . . . . . * "*Eng'ing*," xxvii. 194.
S. S. "Mytho," . . . . . * "*Engineer*," xlviii. 288.
"Orient," . . . . . * "*Engineer*," xlviii. 247.
"Rover," Br. . . . . * "*Engineering*," xxi. 228.
French Navy . . . . . * *Laboulaye's* "*Dict.*," art. "*Bateau à Vapeur*," vol. iv., Figs. 3417, *bis et ter.*
Torpedo boat, *Normand*, Fr. . . * "*Engineering*," xxx. 423.
Tug boat, discon. "Mt. Etna" . * "*Engineering*," xxix. 412.
Rankin, Br. . . . . * "*Engineering*," xxii. 255.
Twin-cylin. direct act., *Bernay's* * "*Engineer*," xlvii. 102.
Variable cut-off, Bolton, Br. . . * "*Engineering*," xxi. 314.
Vertical, *Fowler & Co.*, Engl. . * "*Sc. Amer.*," xxxvii. 191.
Fowler, Br. . . . . * "*Engineering*," xxiv. 126.
Perkins, Br. . . . . * "*Engineer*," xliii. 390.
Watts, Br. . . . . * "*Engineer*," xlvii. 60.
Willam, Br. . . . . * "*Eng'ing*," xxvii. 577.
Yacht "Wanderer," Br. . . . * "*Engineer*," l. 440, 444.

See also the following references: —

Galloway, Gt. Britain. Engine exhibited at Vienna 1873.
See * *Thurston's* "*Rept. Vienna Exposition*" . . ii. 30.
Schneider & Co.'s, Creusot, France, * *Ibid.* . . . . . ii. 31.
Ehrhardt's, Zweibrücken, *Ibid.* . . . . . ii. 31.
Burmeister & Warri, Copenhagen, * *Ibid.* . . . . ii. 51.
Motala Works, Sweden, for twin-screw gunboats, *Ibid.* ii. 59.

Galloway compound condensing engine drove the British machinery at the Paris exposition of 1878.

Compound three cylinder marine engine of the French Navy. *Laboulaye's* "*Dict. des Arts et Manufac.*," vol. iv., ed. 1877, article "*Bateau à Vapeur*," Figs. 3417 *bis et ter.*

See: *Mallet's* "*Compound Engine.*"
Turnbull's "*Treatise on the Compound Engine.*"

Com'press. (*Surgical.*) The pledget compress has been referred to, p. 602, "*Mech. Dict.*"

Arterial compressors are of the nature of tourniquets.

Erichson's, Buck's, and Skey's, Figs. 108-110, Part I. of *Tiemann's* "*Armamentarium Chirurgicum*," Part 1.
Briddon's artery compressor, *Ibid.*, Fig. 112.
Gross's, *Ibid.*, Fig. 156.
Langenbeck's bandage clamp for the *Esmarch* bloodless method of amputation, *Ibid.*, Fig. 111 *b.*
Esmarch bandage clamp, *Ibid.*, Fig. 111.
Tourniquets, *Ibid.*, Figs. 104-107, 113, 114.
Seminal cord compress, *Ibid.*, Fig. 206, Part IV.
Trusses, *Ibid.*, p. 9, Part IV.

Com-pressed' Air Brake. That form of railway-car brake in which air compressed by some form of pump on the locomotive is conveyed by pipes and flexible hose beneath the cars to cylinders and pistons under each car, by which the pressure is transmitted to the brake levers and thence to the brake-shoes.

The *Westinghouse* and *Loughridge* are notable examples. The other class are known as *vacuum* air-brakes.
See also *Colladon's* (Fr.) brake, "*Sc. Amer. Sup.*," *2814.

Com-pressed' Air En'gines and Machin'e-ry. The following references may be examined: —

Lamm's patents are: . .	No. 105,581.	
	No. 121,527.	December 5, 1871.
	No. 124,495.	March 12, 1872.
Tellier	No. 121,909.	December 12, 1871.

See also Air and Gas Engines for propelling cars.

Bompas' English patent .	No. 5,644, 1828, compressed air.
Stewart & Kershaw, Eng. pat.	No. 1,092, 1863, compressed air.
S. Carson, U. S. patent . .	December 9, 1856.
N. H. Barbour, U. S. patent	March 14, 1865, carb. acid gas.

Stewart & Kershaw, cited above, compress air by water-power at stations along the road. The engine has small reservoirs disposed along the center of its frame. Air is first used in high-pressure cylinder, then in low pressure.

Harrison's Air Engine, 3,034, is a turbine, driven by compressed air. See also reaction wheel worked by compressed air, 1,451 of 1866.

See also Air Engine and Compressed Air Engine, "*Mech. Dict.*"

Beaumont, Woolwich, Engl. . .	"*Sc. Amer. Sup.*," 1041, * 3943.
	"*Brit. Trade J.*," June 1, 1880.
Mekarski, Paris	* "*Scientific Amer.*," xl. 51.
	* "*Paris Expo.* 1878 *Rept.*," vol. iv., p. 462-464.
	* "*Sc. Am. Sup.*," 276.
Polytechnic college, Phila. . .	"*Polytechnic Rev.*," Dec. 23, 1876.
Schneider, St. Gothard tunnel .	* "*Sc. Am. Sup.*," xvi. 20.
Bushnell, New York	"*Sc. Amer.*," xxxix. 129.
Haupt's Report on the use of compressed-air motors for street cars	"*Sc. Am. Sup.*," 2795, 2813, 2891.
Lamm & Francq, Paris tramways	* "*Paris Exposition* (1878) *Repts.*," iv. 465.

Zahner's "*Transmission of Power by Compressed Air.*"

See also Air Car	"*Sc. Am. Sup.*," 789.
Air compressor, *Burleigh* . . .	"*Technologiste*," xxxviii. 389.
Air engine, *Beaumont*	"*Sc. Am. Sup.*," xxxvii. 84.
Air locomotive, *Beaumont*, Engl.	"*Sc. Am. Sup.*," 966.
"*Engineer*"	"*Van Nostrand's Mag.*," xxiii. 225.
Air machines	"*Sc. Am. Sup.*," 2448.
Air in mines, *Johnson*, Engl. .	"*Sc. Am. Sup.*," 2223.
Air motor, *Fallart*, Brussels . .	"*Mining and Sc. Press*," xxxvii. 307.
Lecauchet	"*Technologiste*," xxxvii. 116.

Air-pump and condenser.

Tangye, Br.	* "*Engineer*," xlii. 40.
Air pump, "Hartford" . . .	* "*Engineer*," xlii. 298.
Air receptacles, *Siemens* . . .	"*Sc. Am. Sup.*," 1906.
Air (etc.) reservoirs, *Siemens* .	* "*Engineer*," xlv. 287.
Air street car, *Mékarski* . . .	* "*Engineering*," xxii. 142.

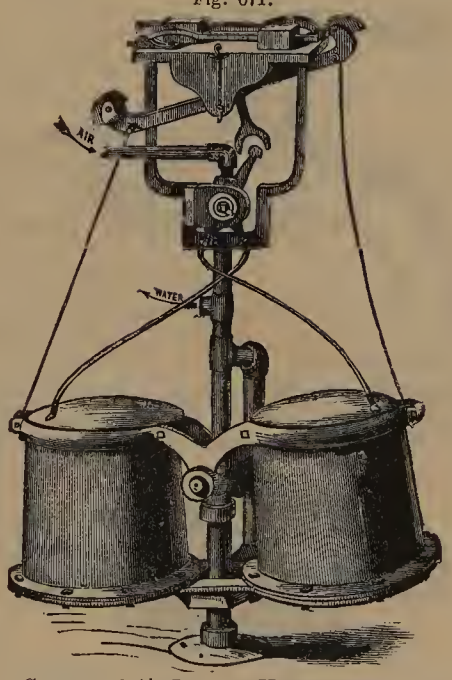
Air, Transmission of power by.

Zahner	"*Van Nostrand's Mag.*," xix. 446, 481.

Com-pressed' Air Pump. A windmill works an air compressing pump, and the air is conducted by a pipe to the submerged apparatus shown in Fig. 671.

Two merged chambers rest upon a frame, pivoted to allow them a certain amount of rocking motion in a vertical plane.

Fig. 671.



Compressed Air Pump. (*Hartford Pump Co.*)

Each cylinder has a valved inlet at bottom, and a discharge pipe at bottom on the inner side, the respective pipes passing to a common upright main. An air valve above determines the access of compressed air to the chambers alternately. This valve is operated by the rise and fall of the chests: the compressed air being always directed to the lower chest. As soon as a chamber is emptied it becomes relatively lighter than the other, ascends, works the lever and valve, and directs the air into the other.

Com-pressed' Fuel. Fuel made of materials artificially compounded and pressed into blocks. See Briquette; Fuel, Artificial.

In the works of the "Crown Preserved Coal Co.," at Cardiff, Wales, the fine coal from the colliers is tipped from the wagons, pulverized, mixed with pitch automatically, passes to the heating furnaces to be made plastic, and is thus delivered to the molds, each of which receives 60 tons pressure, forming the block and stamping the name on it. An endless band carries the blocks to the stacking ground. The blocks are regular in shape, weigh 26 lbs. each, and are made at the rate of 40 per minute.

Com-pressed' Glass. A process by Siemens, of Dresden, Saxony.

The glass is tempered by being cast or pressed in chilled molds. It is claimed to be stronger than the glass tempered in oil by the De la Bastie process (see Tempered Glass) in the proportion of 5 to 3.

The fracture is fibrous; the glass may be bored and wheel polished; is fractured by the diamond.

Siemens . . . . . "*Technologiste*," xxix. 342.

Com-pressed' Gas Gov'er-nor. See GAS GOVERNOR.

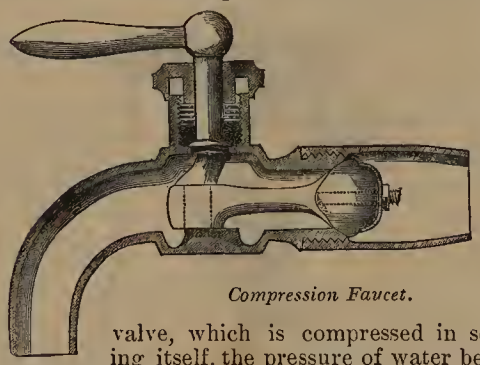
Com-pressed' Steel. (*Metallurgy.*) Steel condensed by hydraulic pressure, while yet fluid, to give it density, tenacity, and freedom from blow holes. See WHITWORTH STEEL.

The principle of compressing metals while fluid, which has been applied with such effect to steel by Sir Joseph Whitworth, has long been in use in copper works. The mold is placed on the table by a hydraulic press, the melted copper poured in from ladles, and a strong cover adjusted to the mouth of the mold by screws. The hydraulic ram is then set to work, and a pressure of about three tons to the square inch applied. The effect is very beneficial to copper, but on brass the result is just the contrary.

Whitworth . . "*Iron Age*," xxiv., Dec. 4, p. 15.
"*Van Nostrand's Mag.*," xv. 536; xvi. 184.
Steel-press, Fig. 5747, p. 2369, "*Mech. Dict.*,"

Com-pres'sion Cock. One with an elastic

Fig. 672.

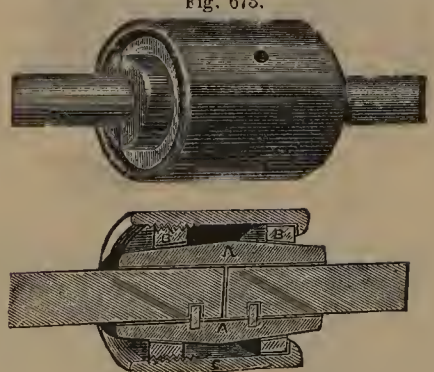


Compression Faucet.

valve, which is compressed in seating itself, the pressure of water being also toward the seat.

Com-pres'sion Coup'ling. A means of uniting adjacent ends of shafts. The compression rings, *B*, are forced up the inclines of the sleeve from

Fig. 673.



Compression Coupling.

each end by a flange at one end and a screw thread at the other end of the cover, *C*, which is rotated by a spanner.

See also CLAMP COUPLING.

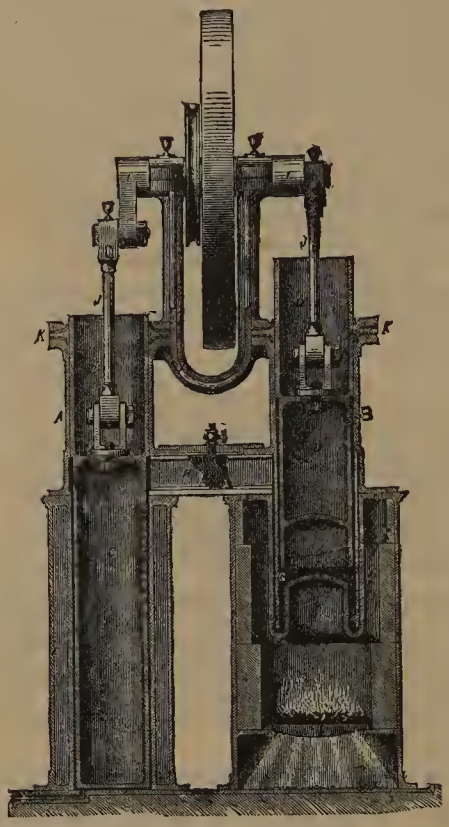
Com-pres'sion Hot'-air En'gine. The terms *hot-air engine, air engine, caloric engine,* are somewhat arbitrarily given.

The *Rider* engine, Fig. 674, is shown as a pumping engine. Cold air admitted to cylinder *A* is compressed to one third its normal volume by the descent of compression piston *C*, the air being transferred through the regenerator *H* into the heater *F* without appreciable change of volume. Heated by the passage through the regenerator and then by the fire, the expansion of the air raises the power-piston *D*, in turn depressing the compression piston *C*, and so on.

"*Scientific American*," . . . * xxxiv. 66; * xxxviii. 131.
"*Railroad Gazette*" . . . . * xxiv. 189.

See also AIR ENGINE; CALORIC ENGINE; HOT-AIR ENGINE.

Fig. 674.



Rider's Compression Engine.

Com-press'or. 1. A device on the stage of a microscope by which an object is compressed between glass plates.

2. (*Surgical.*) An instrument for grasping a uterine tumor and severing the pedicle. An *Ecraseur.*

Com-pres-so'ri-um. A compressor for microscopic objects.

Microscope, *Holman* . . . "*Manuf. & Builder*," xii. 205.

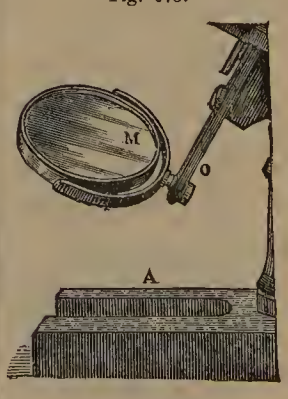
Com'pro-mise Wheel. (*Railway.*) One adapted by an extra breadth of tread to run upon tracks of gages varying say 1½" in width.

A broad-tread wheel.

Con'cas-seur. A French coarse-grinding mill for grain or feed. A *corn cracker.*

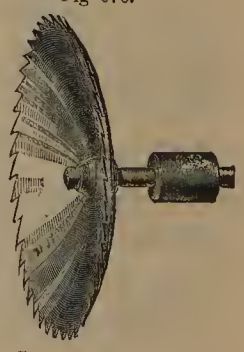
Con'cave Mir'ror. A mirror, *M*, attached to a microscope to throw oblique rays upon the object. It is adjustable in any direction, as, besides swinging in a rotating semicircle, *N*, it is attached to a bar, *O*, with a joint at each end, allowing a lateral movement.

Fig. 675.



Concave Mirror.

Fig 676.



Concave Saw.

Con'cave Saw. A dish-shaped saw for sawing out bowls or curved stuff. See Fig. 676.

Con-cen'tra-ting Ap'pa-ra'tus. An apparatus for eliminating extraneous, refuse, or diluting matter. The term has many applications. See p. 604, "*Mech. Dict.*," and list under METALLURGY, p. 1424, *Ibid.*, for the names of those machines concerned in mining.

Ore, *Richards* . . . * "*Mining & Sc. Press*," xxxv. 161.
Tolles . . . . . * "*Mining & Sc. Press*," xxxiv. 17; * xxxiv. 237.
Beet sugar process, Fr. "*Dept. Agri. Sp. Report*," 128, Pl. XXVI.
For syrups . . . . *Laboulaye's* "*Dict.*," "*Sucre*," iii.
See also CONDENSER, "*Mech. Dict.*"

Con'cer-ti'na. (*Music.*) An instrument of the accordeon family. It is a small elastic box, held horizontally between both hands. It is played by knobs pressed by the points of the fingers, and which, raising a valve, cause to pass over the reeds of brass the column of air supplied by the bellows between the two sides of the box. The sides hold the knobs on the outside, and, on the inside, the vibrating plates. The bellows has no valves, but fills and empties by means of the reed valves, which inspire and expire, each in turn, the air necessary for the vibration of the reeds. The *bass concertina* has the compass of the *violoncello;* the *alto* that of the *viola;* the *soprano* that of the violin.

Con'crete. A mixture of mortar with gravel or spawls.

Architectural treatment "*Scientific American Sup.*," 683.
Blocks . . . . . * "*Manuf. & Builder*," ix. 112.
Woodhouse, Eng. . . "*Iron Age*," xix., Feb. 1, p. 24.
Building . . . . . "*Scientific American Sup.*," 408, 534, 1524.
Bell, Engl. . . . . "*Scientific American Sup.*," 899.
Block lowering, Jersey. * "*Engineering*," xxiii. 282.
Concrete and iron, *Hyatt* "*Scientific American Sup.*," 1939.
Dwelling house . . . . * "*Scientific American Sup.*," 1895.
House building . . . . "*Scientific American Sup.*," 1767.
Fire-proof . . . . . "*Scientific American Sup.*," 921.
Foundation, *Matthews* * "*Scientific American Sup.*," 245.
Mill . . . . . * "*Mining & Sc. Press*," xxxv. 273.
Mixer, *Messent*, Eng. . * "*Scientific American*," xxxvii. 97.
Day & Lampard, Br. . * "*Engineer*," xlv. 354.
Tank . . . . . "*Scientific American Sup.*," 3742.

See also BÉTON, CEMENT, etc.

2. (*Sugar.*) Sugar boiled down to a solid mass; to be worked up subsequently in factories provided with superior machinery. See CONCRETOR.

Con-cre'tor. An apparatus for evaporating sugar, bringing the whole juice of the cane to a solid mass, to be subsequently treated with superior machinery. *Fryer's process.*

The apparatus consists of three parts: 1st, a rectangular pan of cast-iron, made in sections, and in all 25′ or 30′ long by 6′ wide and 6″ deep, with a number of partitions running across, extending alternately from each side nearly to the other, and set with a slight inclination, so that the juice runs in at one end, and in a stratum of not more than ½″ in depth, by a long, zigzag course, escapes at the other. The pan is heated by direct fire from below, and in passing through it about two-thirds of the water is evaporated. The juice, now of syrupy consistence, goes thence to the interior of a hollow cylinder of sheet-copper, heated on the outside by the flue gases from the fire under the pan (or by the vapor from the juice therein), while through the inside a current of air is driven, heated by the exhaust steam of the small engine, which furnishes power. This cylinder is 20′ long by 3′ 6″ in diameter, open at the ends, with the exception of a little rim to retain the syrup, set with a slight inclination from the horizontal, and made to revolve slowly — about 6 or 8 times per minute — on its axis. Thence the syrup, now of thick consistence, passes to the exterior surface of a copper-faced iron cylinder of 4′ in diameter by 4′ long, over which it is evenly distributed in a thin layer. This cylinder is heated from within by exhaust steam, revolves upon its axis twice per minute, and receives on the outside a steady blast of heated air, by which the evaporation is rapidly completed and the syrup brought to the consistence of a soft solid, which is removed by a scraper, and can be molded while warm, but on cooling sets into perfectly hard slabs, ready for storage or shipment. The time required for the passage of any given portion of sugar from end to end of the whole apparatus is only about 15 minutes, and with the above dimensions of parts the product is about half a ton of *concrete* per hour. Of course the arrangement may be used to produce crystallized sugar, but it is specially adapted to its intended use of rapidly putting the crude juice into a condition in which it may be kept free from alteration and in small bulk for shipment, to go in due time into the hands of the refiner.

Mallet's report on Group III., in vol. iv., "*Centennial Exhibition Reports*," 1876.

Con-cus'sion Ta'ble. *a.* An ore-sorting table to which concussion is imparted in order to separate the broken ore by gravity. A *percussion* table.

Rittinger's double concussion table, * "*Mining and Scientific Press*," xxxiv. 217.

b. A species of grain cleaner. See CLOD CLEARER, *supra.*

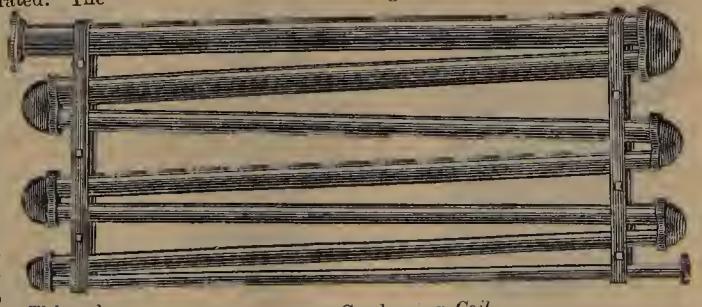
Con-den'ser. A word with several applications, referring to the concentration of volume of an object, as of a solution, a syrup, a gas, an ore, or slime mixed with gangue or impurities.

Pelouze & Andoin's condenser for the mechanical separation of vapor held in suspension by gases. *Smedberg's* improvement. "*Mining & Scientific Press*," * xxxvi. 393.
Dahlgren's fume condenser. "*Sc. American Sup.*," * 629.
McCarter's steam-engine condenser without air pump. "*Scientific American Sup.*," * 643.
Rice's condenser for pharmaceutical stills. "*Scientific American Sup.*," * 1511.
Deane's independent condensing apparatus is a circulatory pump attached to any non-condensing engine, and made at Holyoke, Mass.
Fontenay's marine condenser, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Bateau à Vapeur*," tome i., Figs. 7, 8.
Brossard . . . . . * "*Engineer*," l. 1192.
Steam, *Brossard* . . . . . * "*Sc. American*," xl. 374.
Steam engine, *McCarter*, Br. . . * "*Engineer*," xlii. 112.
Air pump. Separate.
Hathorn, Davis & Co., Br. . * "*Engineering*," xxi. 34.
Exhauster, *Rodger*, Br. . . . * "*Engineering*," xxx. 133.
Exhausting and boiler feed.
Candlish & Norris, Br. . . . * "*Engineering*," xxx. 454.
Feed-water heater.
Robertson & Henderson, Br. . * "*Sc. Am. Sup.*," 2094.
Street cars. Surface, *Rowan* . * "*Sc. Am. Sup.*," 488.
Surface, *Craig* . . . . . * "*Eng. & Min. J.*," xxvii. 89.
Expansion engine, *Nolet*, Belg. . * "*Engineer*," xlvii. 222.
Horizontal engine.
Rusten & Proctor, Br. . . . * "*Sc. Am. Sup.*," 2068.
Paris, 1878 . . . . . * "*Sc. American*," xxxix. 4.
Société Swiss . . . . . * "*Sc. Am. Sup.*," 2084.

A portion of a cotton-gin which acts upon the lint from the gin and presses it into a sort of fleece, in a compacted condition to place it in convenient form for handling, and save room. See GIN, COTTON.

Con-den'sing Coil. A coil in which steam is condensed. In Fig. 677, which represents a condensing flat return-bend coil, the sectional area of

Fig. 677.

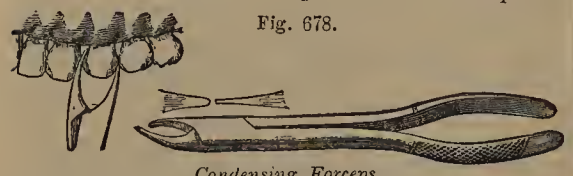


Condensing Coil.

pipe decreases as the steam progressively condenses.

Con-den'sing For'ceps. Dental forceps for condensing plugs situated between the teeth, near their necks or their lingual or palatine edges.

Fig. 678.



Condensing Forceps.

Con'duc-tiv'i-ty. (*Electric.*) The conveying power of an object. Opposed to *resistance*.

Con'duc-tom'e-ter. An instrument for illustrating the comparative power of different objects for conducting heat, electricity, etc.

Con-duc'tor Head. A funnel spout and leading pipe, to conduct a liquid into a reservoir horizontally or nearly so.

Fig. 679.

Conductor Head.

Used in creameries in pouring the milk from the cans of the collecting wagons into the can on the scale inside the receiving-house.

Con-duc'tors' Valve. (*Railway.*) A valve connecting with the Westinghouse automatic brake, and placed at some convenient point in a car, and operated by a cord extending through the car within reach of the conductor.

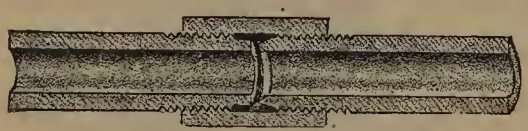
Cone. (*Spinning.*) One of the taper drums in the headstock of a mule, and known as the *backing-off* and *drawing-up* cones respectively.

Cone Gear. (*Add.*) Conical gearing for varying motion was described in *Bramah's* planing machine. English Patent, 1802.

Cone and Cra'dle Mill. A mill which has a conical muller or grinder, reciprocating in a semi-cylindrical concave.

Cone Joint. A pipe joint. The abutting ends of the pipes are conical, and are drawn by a screw-sleeve against a leaden gasket, and thus make a tight joint.

Fig. 680.



Cone Joint for Hydraulic Pipes.

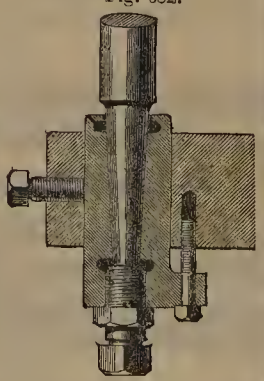
Con-fec'tion-er'y Stove. A sheet metal stove with holes to fit a variety of sizes of confection pans, one at a time.

Steam confection pan, *Brown* . . * "*Engineer*," xli. 226.
French confectionery . . . . . "*Sc. Am. Sup.*," 194.
See also Fig. 1428, p. 611, "*Mech. Dict.*"

Fig. 681.

Confectionery Stove.

Fig. 682.



Richards' Conical Bearing.

Con-form'a-tor. An instrument used in taking the shape of the head at the hat band. Used in shaping hats to fit the head.

Hat conformator and shapes of heads of many distinguished persons, "*Scientific American*," * xxxviii. 143, 146.

Con'ic-al Bear'ing. A compensating bearing for the spindles of shafts in wood machines. The bearing passes through the shell, and the end abuts against the end of an adjustable screw of hard brass having a core diameter equal to that of the spindle. Surrounding the bearing between the end-thrust screw and the spindle is an annular cavity for oil and fibrous packing. Fig. 682.

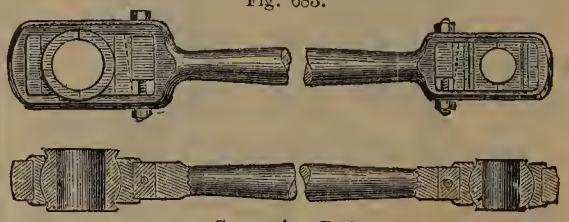
Con-junc'ti-va In'stru-ments. (*Surgical.*) Instruments for operating upon the mucous membrane of the eye and lid.

Scissors curved on the flat . . . . . Fig. 96, Part II.
Pterigium scissors (for removing excrescences from the internal canthus of the eye) . . . . . Fig. 97, Part II.
Caustic holder . . . . . Fig. 97 *b*, Part II.
Brush . . . . . Fig. 97 *c*. Part II.
Of *Tiemann's* "*Armamentarium Chirurgicum*."

Con-nect'ing Rod. A rod intervening between the piston rod or cross-head and the wrist of a crank or driving wheel.

Fig. 682 shows a connecting rod forged in a single piece and mortised for the reception of the brass boxes, which are curved on their backs and fit the cheek-pieces between which

Fig. 683.



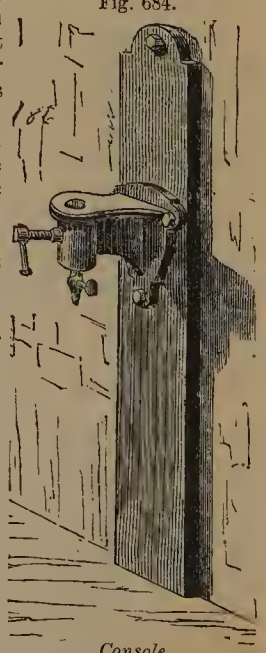
Connecting Rod.

they can turn to adjust themselves to the pins, in the plane of the axis of the rod. The adjustment for wear is by wedge-blocks and set screws.

Connecting rod with solid ends on Brown engine at the Centennial, "*Scientific American*," * xxxvi. 20.

Con'ning Tow'er. The pilot house of an iron clad, usually forward of the funnel in the British practice, and having no sight holes. A reflecting mirror may be exposed above its open top.

Fig. 684.



Console.

Con'sole. A bracket on a wall; in the present case for supporting a hydraulic motor or other object.

Con-sol'i-da'tion. (*Locomotive.*) A type of freight locomotive, the name of the engine, the first in its class, built in 1866, at the Baldwin locomotive works, on the plans of Mr. Alexander Mitchell, to operate a grade of 1 in 40 on the Lehigh Valley Railway, and specially for the Mahony plane, which rises 133′ to the mile.

It had cylinders 20″ + 24″; four pairs of 48″ diameter (pony) driving wheels, connected; and a two-wheel swing truck in front equalized with the front driving wheels. The weight of the engine at work was 90,000 pounds, of which all but 10,000 was on the driving wheels.

Con-sol'i-da'tor. (*Ceramics.*) A system of strainers in which slip is filtered through a series

of bags. The consolidator of Needham and Kite is used in England.

Con'stant Bat'te-ry. (*Galvanic Battery.*) One in which the energy is kept constant by prevention of the polarization of the negative element. That is to say: the polarization of the negative plate is prevented by surrounding the same with a liquid which unites with the hydrogen which is given off from the positive plate.

The Daniell's battery, for instance, has an inner vessel of porous clay in which is a rod of zinc with a solution of sodium chloride, or dilute sulphuric acid; the outer cell has a solution of copper sulphate maintained at saturation by crystals on a shelf.

The action is as follows: when the circuit is closed decomposition of the dilute acid takes place in the inner cell; the oxygen of the acid combines with the zinc to form oxide, which is dissolved by the acid to form zinc sulphate. The hydrogen, set free by the decomposition, is liberated on the surface of the copper element, but instead of remaining meets the copper sulphate solution which is also being decomposed into (1) oxygen, with which it combines to form water; (2) copper, which is deposited upon the plate of the same metal; and (3) sulphuric acid, which permeates the porous cell, replacing that with which the zinc was dissolved, and so automatically refreshing the inner cell.

The depolarizing liquid is usually separated from the exciting liquid by a porous diaphragm or cup, but in the gravity battery the separation is effected by the differing specific gravities of the liquids themselves.

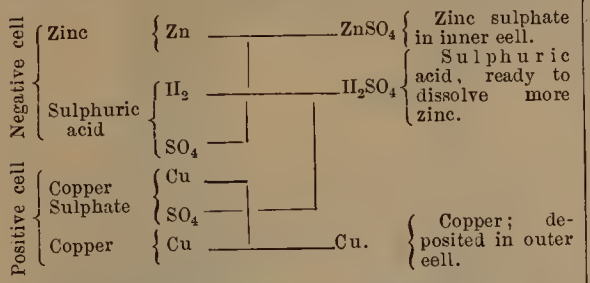
Becquerel's oxygen gas battery was the first constant battery. It was the first to employ two liquids or a porous cell. See BECQUEREL BATTERY.

See also Constant Battery, depolarizing by secondary current, "*Scientific American Supplement*," 764.

The following batteries come within the definition of *Constant*: —

Bunsen battery.	Leelanché battery.
Daniell battery.	Ponei battery.
Gravity battery.	Smee battery.
Grove battery.	Some of which are synonyms.

The following diagram will explain the reactions that take place in a Daniell's cell when the circuit is closed: —



In this diagram the water is not considered, as the reactions are explainable without including it in the statement. See also list under GALVANIC BATTERY.

Con-su'mers' Test Me'ter. (*Gas.*) An apparatus for testing the accuracy of the indications of gas meters *in situ*.

It is usually a 5-light diaphragm meter with a circular dial, the outer circle showing 1′ divided into 10ths, the second circle 10′, and the third 100′ per revolution. The pointers are all adjustable. Unions and gum hose connect the meter with a pedestal and burners. The test-meter is verified by the METER PROVER; which see.

Con'tact Break'er. An arrangement or device to interrupt a circuit. The feature of making and breaking circuit is the essence of numberless telegraphic inventions.

One invented by *Herr F. Niemoller* is thus described: —

"To the middle of a wire stretched horizontally is attached a platinum point which touches the surface of mercury held by a small vessel. The current passes through the wire, and over that part of the wire through which the current passes when all the apparatus in its normal state is a small magnet. This magnet, acting on the current, causes vibrations in the wire, and so breaks and makes contact. The number of vibrations can be readily modified by changing the length of the wire, and as high a number as 1,000 breaks per second can be obtained. By passing an intermittent current over the wire, it can be set in vibration without the intervention of mechanical means. This happens when the fundamental note of the string is in unison with the pitch of the breaker."

Con'tact-vein. (*Mining.*) A vein along the contact plane of, or between two dissimilar rock masses.

Con-tin'u-ous Brake. (*Railway.*) One which is attached to each car of a train, and by connection of the several cars can be operated upon all simultaneously, and from points on the engine and each car.

The systems are various: —

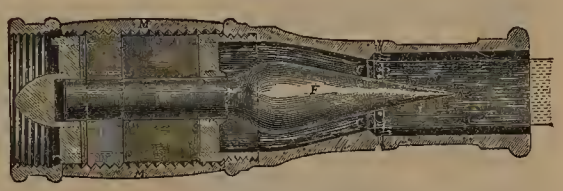
Air compression.	Hydraulic.
Vacuum.	Mechanical.
Steam.	Electric.

Con-trol'ling Valve. A supplementary steam valve adjustable to the maximum amount of steam which the foreman thinks proper to carry, while another valve is used to reduce this quantity, more or less, at the discretion of the workman.

Nash's . . . . . "*Scientific American*," xlii. 166.

Con-trol'ling Noz'zle. A means of controlling the size of a stream issuing from a nozzle, by means of a cone valve *F*, which, by rotation of the sleeve *M*, is projected forward or retracted so as to partially (or entirely) close the opening, or leave the water full scope. By this means the pipeman is able to control the size of the stream according to the abundance and pressure of the water.

Fig. 685.



Controlling Nozzle.

Con-trol' Watch. A time-piece used as a watchman's time detector. See Figs. 7083, 7084, p. 2734, "*Mech. Dict.*"

Con-ver'sion. Changing the bore or fitting of a gun, as —

1. The conversion of a smooth-bore to a rifle.
2. A muzzle-loader to a breech-loader.

A report on the fabrication of wrought-iron tubes at the West Point foundry for conversion of Rodman 10″ smooth-bore guns into 8″ rifles, is contained in the "*Report of Chief of Ordnance, U. S. A.*," 1877, iii., pp. 400-412, and Plates I.–VII. accompanying.

Small arms, French system, *Tabatière*, *Ibid.*, App. L, Fig. 91.

Small arms, English system, *Snider*, *Ibid.*, App. L, Fig. 92.

10″ smooth-bores into 8″ and 9″ rifles, *Ibid.*, 1876, App. H, p. 55.

15″ smooth-bores into 11″ muzzle loading rifle, *Ibid.*, 1879, Appendix H, p. 61.

Con-vert'or. The vessel used in the Bessemer process. See p. 613, "*Mech. Dict.*"

Furnace, *Ponsard*, ...	* "*Engineering*," xxv. 450.
Furnace, Crescent Steel Works.	
Pittsburg	* "*Engineering*," xxiv. 394
Appr. for working	* "*Engineering*," xxv. 99.
Ladle, *Caspersson*	"*Am. Manuf.*," Dec. 31, 1880, p. 12.

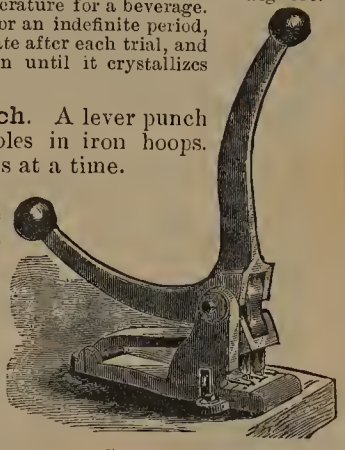
Cool'ing Cup. An invention of Toselli.

It is described in "*Les Mondes*," and consists of a cylindrical cup for holding any liquid into which may be plunged an inner goblet shaped like an inverted truncated cone, and having a lid which rests on the outer cup. Putting 150 grams

of nitrate of ammonia in the inner goblet, filling it with cold water, and stirring it so as to hasten the solution, the temperature of the outer liquid is soon reduced to a sufficiently low temperature for a beverage. The salt may be used for an indefinite period, by spreading it on a plate after each trial, and exposing it to the sun until it crystallizes anew.

Coop'er's Punch. A lever punch for making rivet holes in iron hoops. It punches two holes at a time.

Fig. 686.



Cooper's Punch.

Coop'er-age Ma-chine'. See list under BARREL MACHINERY.

Cop'per. See the following references: —

Ore working	"*Sc. Amer.*," xxxix. 209.
Process, *Roessler*, Ger.	"*Eng. & Min. J.*," xxx. 369.
Hunt & Douglas	* "*Engineering*," xxii. 419, 437.
Smelting process, Altenare	"*Painter's Rept., Vienna Exp.*," iv. 106.
Bukowina proc., 176, Lower Harz.	*Ibid.*, iv. 129.
Hungarian proc., 195, *Mansfield*	*Ibid.*, iv. 133.
Tyrolese	*Ibid.*, iv. 165.
Smelting furn., Swed., Norw., Ger.	*Ibid.*, iv. 21.

Cop'per Bolt. A copper bit; a soldering tool.

Cop'per Cast'ing. Copper highly heated and cast under water, acquires a very beautiful and persistent rose color. A Japanese art. — *Dr. Percy.*

Cop'per-plate Print'ing.

Cylindrical system by roller and scraper, *Godchaux* (Fr.).
Flat plate system, *Robert Neale* (Patented in England, January, 1852).
Hydraulic pressure, *Silbermann*.
Described in article "*Imprimerie*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Cop'y-graph. Writing done on paper with a peculiar ink, preferably aniline, is allowed to dry, and then laid upon a slab of gelatine and glycerine which absorbs the ink and parts with it to paper laid upon it. It yields a large number of copies, if promptly taken.

The following is the recipe for making the slab: Best gelatine or glue, 1 part, soaked over night in cold water and the excess of water poured off; the glue is then warmed in a water bath with from 10 to 12 parts of glycerine, to which is added 4 to 6 parts of freshly precipitated sulphate of baryta and 1 part of dextrine, well mixed with constant stirring. During the summer less glycerine should be added than in winter, as the glycerine softens the mixture, while the glue and dextrine harden it. While soft it is poured into a zinc box and cooled. For ink, the aniline ink called Violet de Paris, is best.

The lithogram, chromograph, copygram, hectograph, and numerous other processes are substantially the same. It is the invention of *Stein*, of Vienna.

Cop'y-ing Lathe. A lathe which reproduces a pattern. This may either be a templet, in which case the slide-rest works against the templet, which thus governs the distance of the tool from the axis of rotation of the stuff. The result is symmetrical. The work may consist of table-legs, billiard-cues, etc.

Another form has a capacity for irregular shapes, the pattern revolving and governing the position of the revolving cutter.

See SPOKE-LATHE, Figs. 5451, 5452, p. 2283, "*Mech. Dict.*"
See LAST LATHE, Fig. 2825, p. 1259, "*Mech. Dict.*"
See LATHE . . Figs. 2836, 2837, p. 1264, "*Mech. Dict.*"

Arbey's (Fr.) copying lathe for lasts, etc., * "*Engineer*," xlvii. 262.

Cop'y-ing Pen'cil. Composed of graphite, kaolin, and blue violet aniline. Gum arabic may be substituted for the kaolin.

See also Ink	"*Sc. Amer.*," xxxvi. 386; xxxvii. 327.
Pad	"*Sc. Amer.*," xli. 325.
Paper	"*Sc. Amer. Sup.*," 2438.
Pencil	"*Sc. Amer.*," xxxix. 344.
Process, *Adler*, Gelatine	"*Sc. Amer.*," xlii. 1.
Alisoff, Polygraphic paper	"*Sc. Amer.*," xlii. 339.
Blue	"*Engineer*," xlv. 279.
Gelatine	"*Sc. Amer.*," xli. 284.
Hannot	"*Sc. Amer.*," xxxvii. 259.
Holtzman	"*Patent*," May 8, 1880, No. 227,629.
Ridout	"*Sc. Amer.*," xlii. 100.
Sars, Lithographic	"*Sc. Amer.*," xxxvii. 326.

See BLUE PROCESS; GELATINE COPYING PROCESS; HECTOGRAPH, etc.

Cop'y-ing Tel'e-graph. See —

Chemical. *D'Arlincourt*	*Lines* "*Rept. Vienna Exp.*," 1873.
Writing	*Laboulaye's* "*Dictionnaire*," ii. art. "*Ecritures*."

See also AUTOGRAPHIC TELEGRAPH; FAC-SIMILE TELEGRAPH.

Cor'al, Ar'ti-fi'cial. Yellow rosin, 4; vermilion, 0.2; melt and mix carefully.

Cord Car'ri-er. (*Surgical.*) A means of carrying a ligating cord to a deep-seated part.

Obstetric cases	Fig. 496 *b*, Part III.
Knot-tyer	Fig. 92, Part I.
Ligature Needle	Figs. 94–96, Part I.
Compress for seminal cords	Fig. 206. Part. IV.

All in *Tiemann's* "*Armamentarium Chirurgicum*."

Cord-mak'ing Ma-chine'. Binns' cord-making machine (Bradford, Eng.), automatic machine for making silk cord, trimmings, fringes, etc.

"*Manufacturer & Builder*" . . . . . xi. 203.

Core. (*Add.*) It is often made of green sand, but usually of core sand, molded in a core box, or of loam struck up upon a spindle or core plate; it is dried and black washed. It must be sufficiently strong to bear the flow of metal around it, and sufficiently porous to allow free vent for the gases. There are many varieties: —

Dry sand.	Molasses water.
Flour.	Glue water.
Steam flour.	Sour beer.
Loam and sand.	Brickbat.
Rosin.	Charcoal.

(*Electricity.*) A bundle of wires in the center of the helix, made of soft iron, so that it may magnetize and demagnetize as rapidly as possible.

Core Lift'er. A collar or thimble lowered into a bore, made by an annular rock drill, in order to bring up the core left by the drill. The collar is of the size of the bit, and has on its interior periphery a catch which, on the retraction of the collar, engages the core and lifts it to the surface.

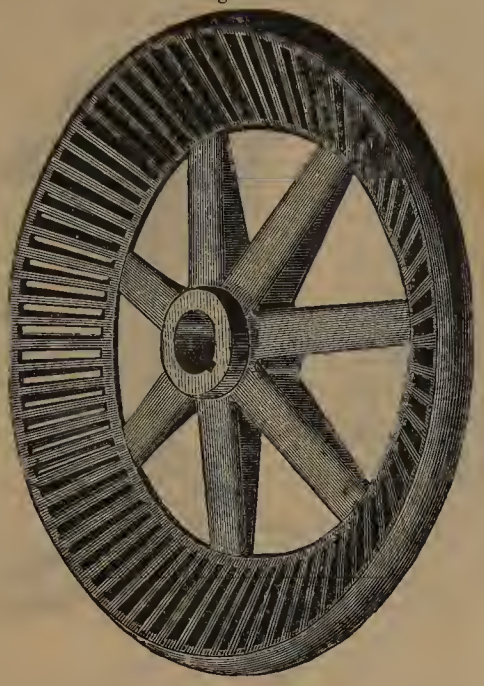
Core Wheel. A wheel with recesses which answer as the interspaces of cogs, or into which wooden cogs may be driven. Fig. 687. Such a wheel is made with cores, which are placed in the mold to form the openings in the wheel.

Cork Arm'-board. (*Leather.*) A graining-board, made of the outer or dead bark of the cork-oak. It has no grooves.

Cork Board. Ground cork incorporated with paper pulp in mixing machines and with powerful presses. The material is springy, light, a poor conductor of heat and sound. A French invention.

Cork'ing Ma-chine'. The form of corking machine used at Bordeaux is shown in Fig. 688. The bottle is placed on its stand, a pan being placed around it to catch the wine in case any bottle should break. The cork is in the sleeve immediately about the mouth, and is forced into the bottle by the piston operated by the lever. It is simple and efficient.

Fig. 687.

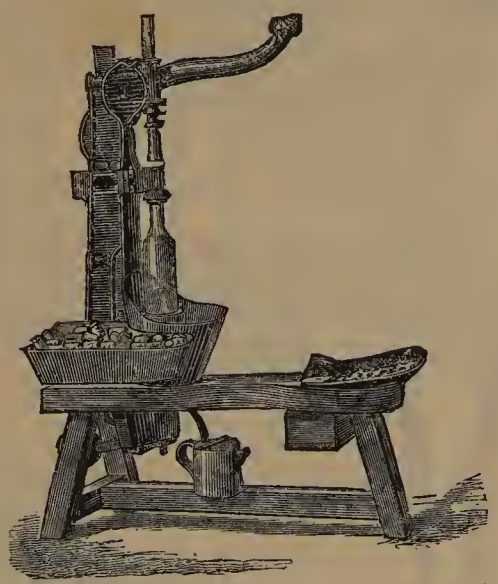


Core Wheel.

Cork Leath'er. Fine slices of cork placed between and attached to layers of leather. *De Beereski & Co.*, Fr.

Slices of cork coated on each side with India-rubber solution; on one side a sheet of cloth can-

Fig. 688.



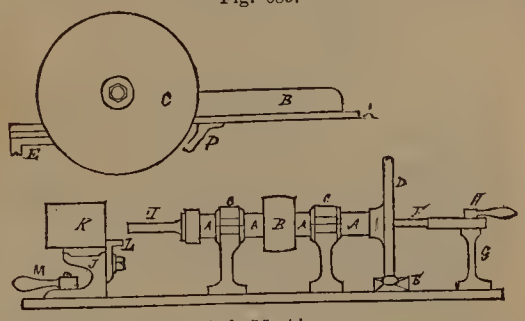
French Corking Machine. (Système Gervais.)

vas or thin leather is laid, and on the other a cotton or linen fabric. The laminated fabric is then pressed between rollers. To be used for trunks, driving belts, etc. Veneered with wood for panels. *Block*, Engl.

Cork Ma-chine'. Armstrong's machine for making corks is shown in Fig. 689. The upper figure is the machine for cutting the slab of cork into strips. The cork-slab is laid on the iron table *A*, which is secured by lugs *D E* to a wooden table. *C* is the revolving knife and *B* the gage.

In the lower figure, *A* is a hollow spindle driven by the pulley *B*, and capable of slipping back and forth in its bearings in the standards *C C*. On the right-hand end of the spindle *A* is the flange *D*, the edge of which runs in a groove in the lever *E*, the latter giving the spindle its end motion. On the other end of the spindle *A* is the tubular cutter *I*, which has parallel sides, and an edge produced by beveling

Fig. 689.



Cork Machine.

off the outside. *F* is a long, stationary rod, which runs from the set screw *H* through the spindle *A*, and nearly through the cutter *I*. A piece of cork being placed against the block of hard wood *R*, resting on the gage *L*, the lever *F* is moved, bringing the spindle *A* to the left, and forcing the cutter through the cork. Being retired, the central rod *F* forces the cork out of the cutter. *M* is the mode of adjustment for the abutment *J*.

The cork is tapered by presentation to a steel disk, while itself is slowly rotated

Armstrong . . . . . * "*Scientific American Sup.*," 528.
Procuring cork . . . * "*Scientific American Sup.*," 2649.

Cork'screw. Fig. 690 shows the lever for lifting the corkscrew and the cork out of the bottle without jarring it or disturbing the contents. A collar on one arm rests on the flanged lip of the bottle, and the other arm has its bearing under a collar on the cork-screw stem.

Fig. 690.

Lever Cork-screw.

Cork'screw Ma-chine'. A machine for twisting steel wire into corkscrews. Clough & Williamson.

Cor'liss En'gine. A form of engine described under CUT-OFF, which see.

See also references as follows: —

At Centennial . . . . . * "*Engineering*," xxii. 12.
"*Iron Age*," xvii., April 13, p. 11.
* "*Harper's Weekly*," May 27, 1876.
"*Scientific Am. Sup.*," 402
And boilers . . . . . * "*Scientific Am. Sup.*," 294
Horizontal, compound, Bombay * '*Polytechnic Rev.*," ii. 1.
Harris-Corliss . . . . . * "*Sc. Amer.*," xxxv. 95.

Corn Clean'er. A machine with a combined rolling screen and suction fan, for the separating of cobs from shelled corn, and the cleaning of the corn for shipment.

Corn Crack'er. A farm or plantation mill having an outer iron shell with a corrugated inner surface, and a core or cone with sharp projections which, rotating within the shell, coarsely grinds the corn for stock feed. Used for grinding on the cob.

The British corn-mill is for grain of any kind for feed; *corn* being generic there, not *maize*.

Ransome's, Br. . . . . * "*Engineering*," xxvii. 319.

A pair of conical rollers on a horizontal axis rotating and revolving in a flat pan.

Guardiola . . . . . * "*Scientific American*," xxxvi. 83.
Grater, *Wood* . . . . * "*Scientific American*," xlii. 324

Corn Cul'ti-va'tor. See CULTIVATOR.

Corn Cut'ter. A large form of straw-cutter, adapted by size and power for cutting maize stalks. Corn fodder is thus prepared by some, and with great advantage, but the principal use of the machine is for cutting the green corn stalks for ensilage. See ENSILAGE CUTTER.

Corn-cutting machine (barn).

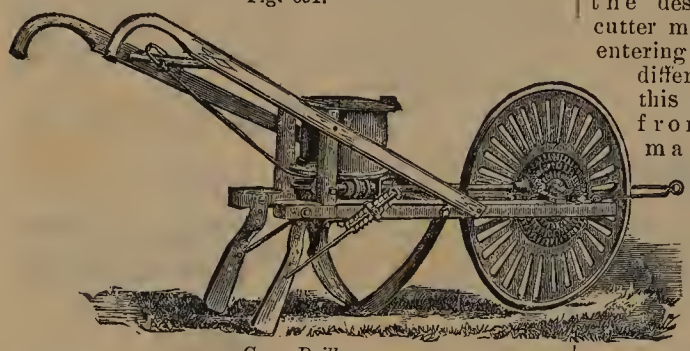
Dick . . . . . * "*Mining & Sc. Press*," xxxv. 225.
* "*Scientific American*," xxxvii. 115.
Silver & Deming . * "*Iron Age*," xix., Jan. 4, p. 5.

Corn Drill. A machine for planting corn in drills. The machine for planting it in hills is called a CORN PLANTER, which see.

Drills and planters are made for either one or two horses, and also to be worked by hand.

In the *Campbell* corn-drill a slotted solid wheel acts as a roller in breaking clods, and helps to prepare the seed-bed for the corn. It also is the drive-wheel which through its pitman rod and geared connections automatically operates the force-feed of the seed from the hopper, which, dropping down through the hollow share that has just provided its bed, is followed by the adjustable covering shares that

Fig. 691.



Corn Drill.

complete the work. A fender in front curving back to the point of the seed-share clears the track.

There are three circles of cogs on the drive-wheel which give three different rates of feed, dropping a grain of corn at greater or lesser intervals, say from 12″ to 20″.

Cor'ne-al In'stru-ments (*Surgical.*) This includes *paracentesis*, and *cataract* instruments.

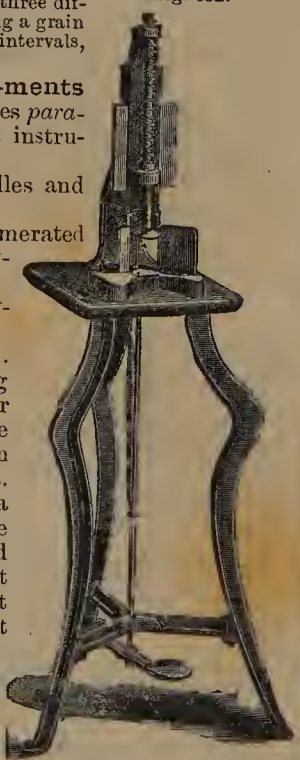
The former are needles and trocars.

The latter are enumerated under CATARACT INSTRUMENTS, which see.

See also IRIS INSTRUMENTS.

Cor'ner Cut'ter. 1. A machine for cutting the corners off cards or books. Pass-books have the corners removed in order to avoid dogs-ears. The machine makes a round corner. Some cards are also rounded on the corners to suit the fancy or prevent bending too readily at the corners. Some playing cards are thus trimmed. The machine works by a treadle, or by power; in the former manner in Fig. 692. The spring clamp descends upon the object and holds it while the cutter descends, and cuts through the book to the wooden block beneath it.

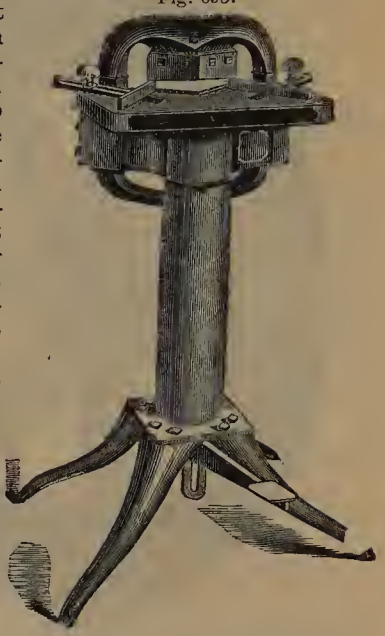
Fig. 692.



Round-corner Cutter.

2. A machine for cutting out notches from blanks of cardboard, intended to be bent up to form boxes. The making of a corner notch, and the scoring partially through at the bending places, prepares the blank for being bent into shape.

Fig. 693.



Box-maker's Corner Cutter.

Fig. 693 shows a treadle motion corner cutter. The blank is laid on the table and the descending cutter makes an entering angle, differing in this respect from the machine, Fig. 692, which merely rounds the salient angle of the book or card. See PAPER-BOX MACHINE, page 1616, "*Mech. Dict.*," where various methods and forms of cutting are represented.

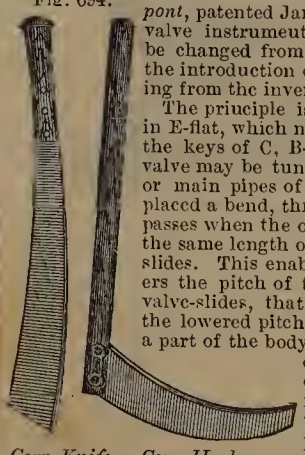
Cor'ner-ing Ma-chine'. A machine for rounding off the corners of stuff; especially used in implement and carriage work. See CHAMFERING MACHINE.

Cor'ner Valve. A valve at a corner, or bend in a pipe. See ANGLE VALVE.

Cor'net. (*Music.*) The cornet with three pistons and with cylinders has a compass of two octaves and two or three notes. Its mechanism allows of its giving all the chromatic degrees within its range.

Cornets are of many varieties as to key, and some have lengthening pieces by which the tone is lowered, but the facility of modulating by the pistons renders this mode of variation less needful.

Fig. 694.



Corn Knife. Corn Hook.

The "Four-in-one" cornet of *Conn & Dupont*, patented January 22, 1878, is a sliding valve instrument, so constructed that it may be changed from a higher to a lower key by the introduction of additional piping. Quoting from the inventors:—

The principle is this: First build a cornet in E-flat, which may be lowered in pitch to the keys of C, B-flat, and A. Now, that the valve may be tuned to correspond with open or main pipes of the horn, on each valve is placed a bend, through which the air-current passes when the open tone is used. Precisely the same length of pipe is added to the valve-slides. This enables the player when he lowers the pitch of the cornet, to draw out the valve-slides, that they may be in tune with the lowered pitch This bend on the valves is a part of the body of the instrument when the open tone is used, but is cut off and its equivalent transferred to the valve-slides when the valve tones are produced."

See also cornets and horns, Fig. 2564, page 1122, and pages 1500-1501, "*Mech. Dict.*," where musical instruments are listed and classed in order of their nature and also alphabetically. See also Fig. 3263, page 1498, *Ibid*, for table of the compass of instruments and voices, showing the place which each occupies on the scale.

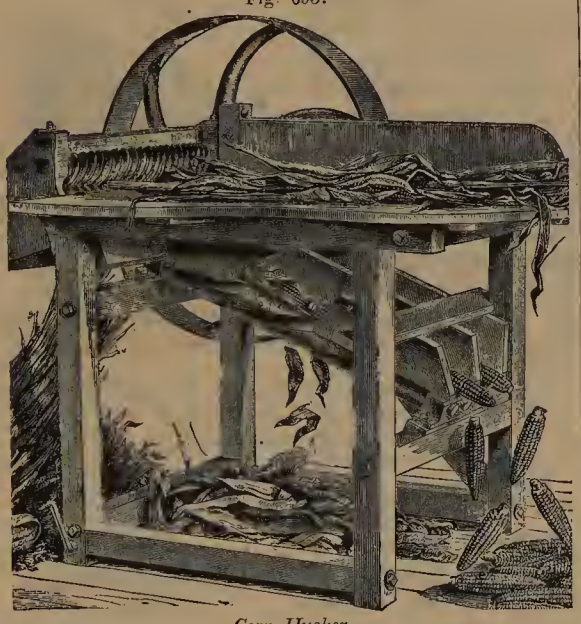
Corn Hook. A hand implement for cutting corn on the stalk. It is used by a draw motion, pulling upward. Fig. 694 shows the corn knife and corn hook. See also CANE KNIFE; MACHETE, *infra*.

Corn Husk'er. A machine for husking ears on the stalk.

Across the end of the frame near the top are placed two picking rolls provided with spiral grooves between which the stalks are fed, so that passing through the rolls they are divested of the ears both large and small. The stalks then drop upon an elevator and are taken away.

The ears, as they are severed from the stalks, drop upon the husking rolls that are placed lower down in the frame, at right angles to the picking rolls, and in an inclined position. Upon the surface of these rolls are spiral grooves for the purpose of allowing spikes to be put on the surface of the opposite roll, and also to allow the ear to settle down between the rolls, so that the hold upon the husk may be more certain. These depressions and spikes being arranged spirally upon the rolls, holding the husks at one end of the ear, and continuing the grasp to the opposite end, make the process of stripping the husk very similar to husking by hand.

Fig. 695.



Corn Husker.

As the ears slide down over the rolls, the husks, being torn off by the steel spikes, are dropped upon the elevator, while the ears pass on to the end of the rolls, and are there received into a basket, thus delivering the stalks and husks in front, and the corn in the rear of the machine at the rate of from 25 to 50 bushels per hour according to the condition of the corn, etc.

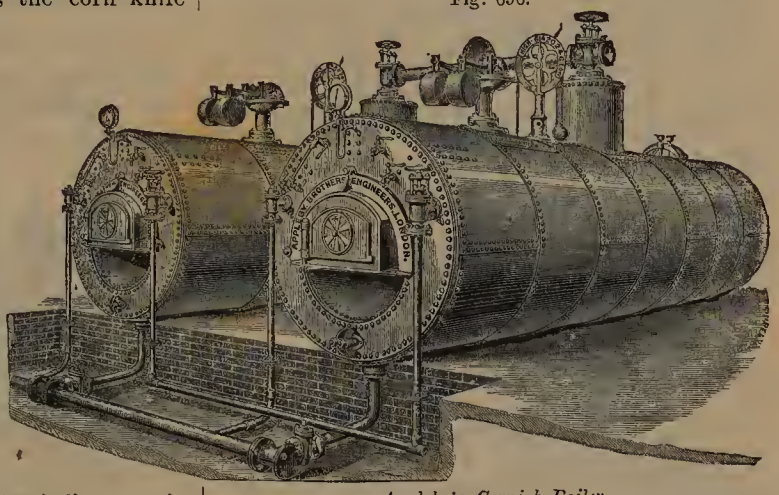
Cor'nice Ma-chine'. 1. A machine for shaping sheet metal into sham cornices for buildings.

2. A machine for planing wood into shapes for interior wall cornices.

Hayes . . . . . * "*Manufacturer and Builder*," xi. 217.
* "*Iron Age*," xxii., May 15, p. 7; May 22, * p. 3; * xxiv., Oct. 2, p. 7.
Sheet metal . . . * "*Iron Age*," xviii., Sept. 7, p. 17; Oct. 26, * p. 1.

Cor'nish Boil'er. A boiler formerly made wagon-shaped (*A*, Plate LXI., opp. p. 2326, "*Mech. Dict.*") but now of a stronger form, cylindrical, higher pressure being required than in the atmospheric engine, where steam was only used to fill the space below the piston, in order that by its condensation a partial vacuum might be produced, and the pressure of the air, acting upon the top of the piston, should depress the latter and with it one end of

Fig. 696.



Appleby's Cornish Boiler.

the walking-beam, lifting by consequence the pump-rod at the other end of the beam.

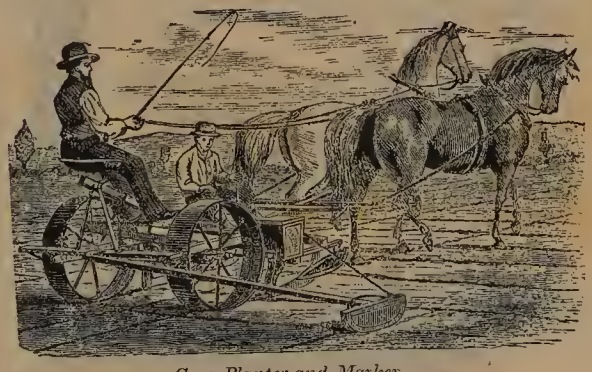
Fig. 696 shows two of a battery of Cornish boilers of the form built by Appleby Brothers, of London, for the locomotive shops of the East Indian state railways. The fittings consist of a furnace front with ventilator, grate bars, bearers, dead-plate, and damper, man-hole and mud-hole, with mud-hole cover and bridge, stop-valve, safety-valve, feed-valve, gage-cocks, glass water-gage, Bourdon's steam-pressure gage, blow-off cock, fusible plug in the crown of each tube, and high and low-water indicator.

Cor'ni di Bas-set'to. (*Music.*) A reed instrument like a clarinet in F (low), excepting that it has a brass bell-mouth, which elongates its lower extremity and descends to a lower note.

Cor'no In'glese. (*Music.*) A double reed instrument, the alto of the oboe, with a compass of $2\frac{1}{6}$ octaves. It is written on the G clef.

Corn Plant'er. Walking, riding, and hand corn planters are shown on pp. 626, 627, "*Mech. Dict.*" Fig. 697 shows a complete machine, with

Fig. 697.



Corn Planter and Marker.

the driver, dropper, and marker. The weights of the operators practically balance each other. The shape of the runner makes a distinct channel in the ground for the reception of the seed. The depth of the channel is regulated by shoes over the faces of the runners. By projections on the wheels conforming to the width of the channels the earth is pushed over the corn, and the furrows are rolled by the broad-faced wheels which support the machine. The planter can be thrown out of the ground when turning at the end of the row and held in position by a catch, until the point of starting on a new bout is reached, when, by a move-

ment of the foot of the driver, the machine is again placed in working position.

The machine is used principally for planting in check-rows by placing a boy on the machine to move the lever when crossing the check-marks, or is made to act automatically as a drill or hill-planter when check-rows are not desired. The marker shown as projecting from the off-side is to mark the ground as a guide for the next bout; when returning, the marker will be shifted to the near side, and so on alternately as the machine goes to and fro across the field.

In the bottom of each hopper is a round dropping-plate with a circle of pockets: into these the grain falls, and the rotation of the plate brings the hole over the tube and the corn passes by the tube to the open furrow at the heel of the runner. The motion of the dropping-plates is derived from the wheels, and different dropping-plates are used for different quantities of seed, 1, 2, 3, or 4 kernels; optional pinions used for dropping in drill-rows are of sizes for dropping at 19″, 15″, 10″, 7″, distance respectively.

The single row planter has the appearance of the walking cultivator, Fig. 1468, p. 627, "*Mech. Dict.*," or of the machine shown at CORN DRILL, *supra*.

Check row planter, *Graetzel*, * "*Scientific Amer.*," xlii. 243.
Corn planter, *Du Souchet* . * "*Scientific Amer.*," xl. 99.
Hand planter, *Noel* . . . * "*Scientific Amer.*," xxxiv. 86.

Corn Plow. The principal corn plow is a cultivator, and is considered under that caption.

There are, however, special plows made for corn and for cotton cultivation, some of them adapted for either. Those with shifting shares, for operating upon the growing plant at different stages of its growth, are considered under *combination plow*.

Single and double plows and several other forms, mentioned in the list under AGRICULTURAL IMPLEMENTS, belong to this order.

Corn plow and marker, *Burns*, * "*Sc. American*," xxxix. 99.
See also CULTIVATOR.

Corn Sheller. A machine for removing corn from the cob. See "*Mech. Dict.*," p. 628.

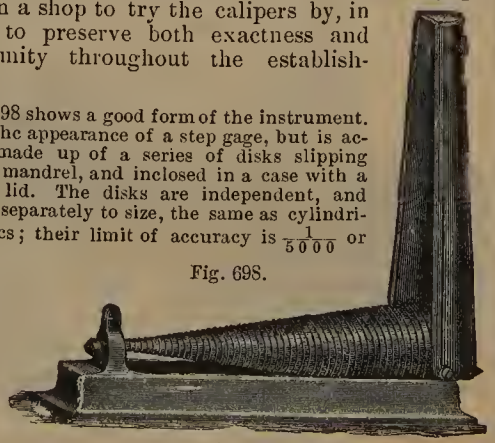
Goddard . . . . . * "*Scientific American*," xxxvi. 134.
Hutchison . . . . . * "*American Miller*," v. 6.
Livingston & Co. . . * "*American Miller*," v. 15.

Cor'po-ra'tion Stop. A stop cock in a gas or water main, outside of a house, to be used by official parties only.

Cor-rect'ive Gage. A correct standard gage, kept in a shop to try the calipers by, in order to preserve both exactness and uniformity throughout the establishment.

Fig. 698 shows a good form of the instrument. It has the appearance of a step gage, but is actually made up of a series of disks slipping upon a mandrel, and inclosed in a case with a hinged lid. The disks are independent, and ground separately to size, the same as cylindrical gages; their limit of accuracy is $\frac{1}{5000}$ or

Fig. 698.



Corrective Gage.

$\frac{1}{10000}$, according to the precision required, and the limit of expense. The sizes are from ¼″ to 2½″ by 16ths; from 2½″ to 4½″ by 8ths, making 49 sizes.

Cor-ru-ga'ted Boil'er. A form of house-heating or greenhouse boiler, which occupies a position inside a furnace, and the shape of which exposes a large surface to the fire.

Cor'si-can Fur'nace. Another name for the Catalan furnace. See CATALAN FORGE.

Co-run'dum. A crystalline alumina used as an abradant.

As a cutting agent, *Jenks* . . . . "*Sc. Am. Sup.*," 972.
Occurrence and distribution . . . "*Sc. Am.*," xxxix. 193.
"*Sc. Am. Sup.*," 672.
Wheels, paper on, by *Bateman*, Engl. "*Sc. Am. Sup.*," 1989.

See Report of *J. M. Safford*, "*Centennial Exhibition Report*, Group I., vol. iii., p. 189: Localities, Varieties, Mode of preparing.
See also EMERY; EMERY WHEEL.

Co-run'dum Points. (*Dental.*) A grinding and abrading tool used on the end of the spindle of

Fig. 699.

Dentists' Corundum Points.

a dental drill; either in mechanical or operative dental operations.

The set consists of wheels, olives, points, cherries, cones, etc.

Co-run'dum Tool. A grinding tool made of a block compounded with emery, or faced with the same.

Fig. 700.

Millstone Facing Tool.

The term is somewhat generic, a multitude of tools deriving their virtue and usefulness from degraded corundum; but the specific application of the term, in the present case, is to a tool for dressing the surface of millstones, restoring the natural grit; the flat for trueing the face, and the angles for the furrows. See MILLSTONE DRESSER.

Co-si'na. A dye produced by Dr. Carr of Stuttgart, Germany. Its solutions in alcohol are of a delicate rose color in transmitted, and a pure yellow in reflected light.

Prepared from fluorescin, by treatment with bromine in combination with potash.

"*Scientific American*" . . . . . xxxiv. 130.

Cos'mo-graph. An instrument resembling an armillary sphere for popularizing astronomical knowledge, erected as a public monument.

Fig. 701.

Rivière's Cosmograph.

The long rod indicates the earth's axis, and points to the polar star; the vertical circle is the meridian; the circle at right angles thereto the equator; a vertical point shows the zenith; others mark the tropics and polar circles.

See also ARMILLARY SPHERE, Fig. 336, p. 149, "*Mech. Dict.*," and TELLURIUM, * p. 2525, *Ibid.*

Cos'mo-scope. An instrument to demonstrate the positions, relations, and movements of the sun, earth, and moon. A form of orrery. *Lexcellent*, "*Technologiste*," * xl. 125.

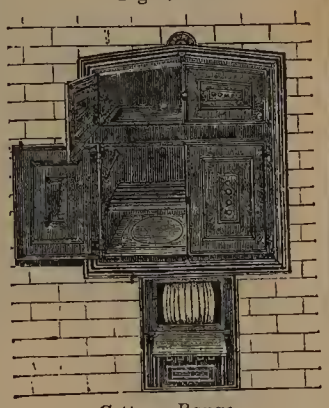
Cos'mo-ra'ma Lens. (*Optics.*) A large-sized double or plano-convex lens.

Cos'to-tome. (*Surgical.*) Rib-cutter. A post-mortem chisel or shears for openiug the thoracic cavity.

Chisel costotome, Fig. 322; shears costotome, Fig. 68; Part I., *Tiemann's "Armamentarium Chirurgicum."*

Cot'tage Range. An elevated oven range with dividing horizontal flue, making a direct draft around the lower and upper ovens.

Fig. 702.



Cottage Range.

Cot'ton Cul'ti-va'tor. A three-share, expansible-frame, wheelless cultivator.

Cot'ton Cyl'in-der. A roller used in drawing fibers or slivers in cotton machinery. See Drawing, Drawing-frame, "*Mech. Dict.*" Osgood's substitute for the ordinary cylinder, covered with cloth and leather, is gelatine treated with bichromate of potassium.

"*Scientific American Supplement*" . . . . . 223.

Cot'ton Gin. See Gin.

Cot'ton Hold'er. (*Surgical.*) A staff to hold a pledget of cotton or lint for application to a wound or cavity.

Cot'ton Ma-chin'er-y. The following list gives the series of machines shown by the Willimantic Linen Co. in their complete exhibit of machines, from the bale of cotton to the spool thread; working upon sea-island cotton. Atlanta Exhibition, 1881.

Cotton gin.
Cotton picker.
Three Foss & Pevey cotton cards.
Railway head.
Comber doubler.
Comber.
First drawing frame.
Second drawing frame.
Slubbing frame.
Intermediate frame.
Roving frame.
Ring spinning frame.
Bobbin spooler.
Two-ply doubler.
First twisting frame.
Spooler.
Three-ply doubler.
Second twisting frame.
Reel.
Skein spooling machine.
Winding machine.
Ticketing machine.
Automatic spool turning machine.
Color card winding machine.

New cotton machinery * "*Engineering*," xxx. 484, 512.
* "*Engineer*," l. 383, 437.
Dobson & Barlow . . * "*Scientific American Sup.*," 2756.
Copping apparatus . . * "*Engineering*," xxx. 484.

Cot'ton Op'en-er. A machine in which bale cotton is picked to pieces, opened, shaken, and blown, to make it separate and light, and remove dirt. It is delivered in a fleecy condition in a sort of lap.

Cotton cleaner . Figs. 1485, 1486, pp. 633–634, "*Mech. Dict.*"
Buckley . . . "*Scientific American Sup*," 1749.

Cot'ton Parch'ment. A material made in sheets by the following process. Cotton fiber, cleaned, digested in a solution of sulphuric acid, glycerine, aud water. Rolled into sheets.

Sylvestre . . . . . "*Technologiste*," xliii. 170.

Cot'ton Pick'er. A machine for picking cotton from the boll, in the field. Fig. 1488, p. 635, "*Mech. Dict.*" See also: —

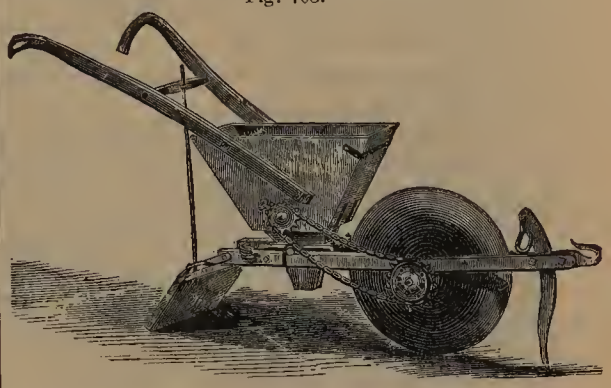
Powell . . . . * "*Scientific American*," xxxviii. 86; xxxvi. 84.
Lynch . . . . * "*Scientific American Supplement*," 240.
Smith . . . . U. S. Patent, April 10, 1877.

Cot'ton Plant'er. A machine which opens a furrow, drops the cotton seed, and then covers it.

There are many machines for the purpose. A force feed is useful on account of the fibrous clinging quality of the seed.

Conner's cotton planter, Fig. 703, has a tooth in front, followed by the disk wheel, which makes the seed-bed. The drive wheel, through an endless chain, operates the force feed in the hopper that furnishes the seed, and is followed by a coverer that is pivoted to the frame of the planter, and adjusted and held in position by a rod to the handle frame above.

Fig. 703.



Cotton Planter.

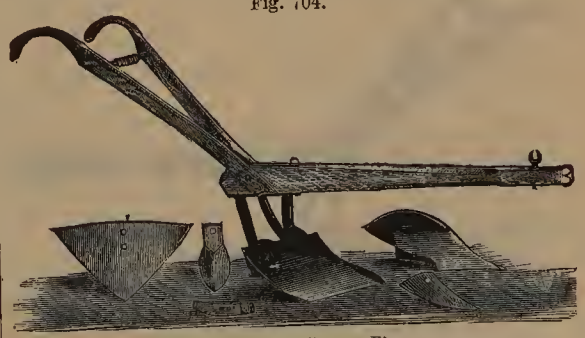
The "Globe" cotton planter gave the best satisfaction at the Atlanta Exposition. It has a barrel which rolls over the ground, being supported by end wheels. Around the equator of the barrel are round holes for the seed to issue. A hoop closes them or opens them to any extent. A spiked shaft in the middle remains stationary while the roller and contents revolve. This keeps the seed stirred. It has the opening share and covering board respectively in advance and rear of the seed cylinder.

Seymour . . . . . * "*Scientific American*," xxxiv. 54.

Cot'ton Plow. A form of cultivating plow differing but little from that employed in tending other crops which are planted iu rows and plowed during growth.

Avery's combination cotton plow has adaptations for various duties in cotton tending, as turning plow, scraper sweep, shovel-plow and bull-tongue; five

Fig. 704.



Combination Cotton Plow.

implements with one stock. The half shovel and scooter may be added if desired.

The rudder wheel acts as a guide, and as a fulcrum in turning or regulating depth, and preventing the implement from dodging and shooting into the line of plants.

See also Combination Plow.

Cot'ton Pow'der. See Tonite.

Cot'ton Press. See Baling Press, "*Mech. Dict.*," *et supra.* Also: —

Compress, *Burr* . * "*Scientific American*," xxxvii. 159.
Hydraulic, *Taylor* * "*Engineering*," xxv. 190.
* "*Scientific American*," xxviii. 15.

Watson, Br. . . . * "*Engineer*," xlv. 38.
* "*Scientific American Sup.*," 1808.
Wilson . . . . * "*Engineer*," xliv. 329.
* "*Scientific American Supplement*," 39.

See list under PRESSES; and REPRESSING PRESS, Fig. 4624, p. 1919, "*Mech. Dict.*"

Cot'ton Scra'per. A cotton cultivator for scraping the earth to or from the plants, as may be required at different periods of the cultivation. The scraper share is shown attached to the stock in COTTON PLOW, which see.

Cot'ton Spin'ning. The Clement process for spinning cotton direct from the seed cotton is mentioned in many of the journals of the day.

"*Engineering and Mining Journal*" . . . . xxviii. 423.
Louisville "*Evening Post and Press*" . . . . Dec., 1879.

The machine is a combined gin and card, making slivers from seed cotton.

It consists of a 36″ top-flat self-stripping card; the attachment (which is a diminutive gin 18 × 18 × 36″), is substituted for the licker-in and feed rollers of the card; its saws are 7″ in diameter, with fourteen teeth to the inch, and revolve from 100 to 200 times per minute. The brush connected with the saws is a cylinder covered with bristles; its periphery revolves a little faster than the saws, and has also a traverse or horizontal motion. The periphery of the card travels a little faster than the brush; a feed table is placed above the card and connected with the attachment by a chute, and gives a regular supply of seed cotton to the attachment. A stop-motion is used to save waste in case of accident. These, with a small drawing roller between the doffer and calender rollers, to reduce the sliver to the ordinary working size, and a cam motion to receive said sliver, are all the changes and additions made to the card.

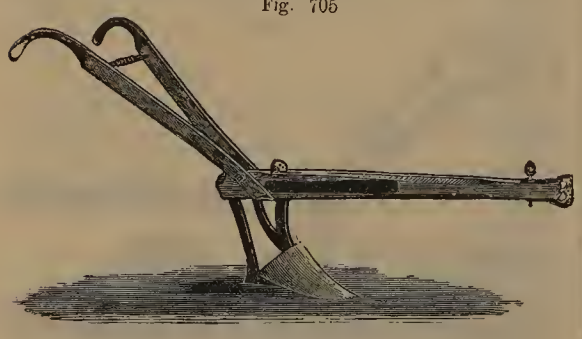
The seed cotton is spread upon the endless apron of the feed table, and passes thence through the chute into the attachment, where the lint is removed from the seed, and while on the fine saw teeth (after passing the ribs) passes through a set of combing plates, which removes all extraneous matter, and delivers the filaments to the brush, which delivers them to the card, and thence through the doffer, small drawing and calender rollers; being delivered as perfect sliver into a revolving can.

Cot'ton Stalk Pul'ler. A machine for pulling out of the ground the old cotton stalks preparatory to chopping or making into windrows and burning.

Brown . * "*Scientific American*," xxxiv. 358; * xxxvii. 230.

Cot'ton Sweep. (*Agric.*) A form of plow used in cultivating the balk between cotton rows: also used in corn cultivation.

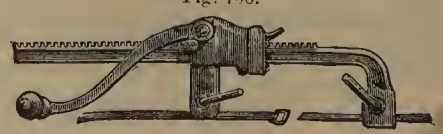
Fig. 705



Cotton Sweep.

Cot'ton-tie Fast'en-er. An apparatus to draw together the ends of cotton-bale ties, in order that they may be riveted or buckled: generally the latter, though the buckle is really but a square loop, around which the ends are bent. See BALE TIE, Fig. 540, p. 218, "*Mech. Dict.*," where 30 kinds are illustrated.

Fig. 706.



Cotton-tie Fastener.

The *Greenleaf* cotton-tie fastener is a clamp, the two members holding each a tie and approached by means of a crank pinion and rack.

Cot'ton Truck. A two-wheeled truck, the sides ending in flat points instead of the usual loop.

Cot'ton Worm De-stroy'er. Apparatus for destroying the cotton worm. There are numerous forms: some adapted for rose, potato, vine, and melon bugs.

Comstock's "*Report upon the Cotton Worm*," U. S. Agric. Depart., 1879, gives varied information on this subject and shows the following apparatus: —

Whitman, fountain pump sprinkler . . . . * p. 239.
Daughtry, spraying machine . . . . . * p. 242.
Willis, atomizer . . . . . * p. 243.
Johnson, sprayer . . . . . * p. 245.
Young, sifter . . . . . * p. 246.
Allen, duster . . . . . * p. 247.
Willis, sifter . . . . . * p. 248.
Davis, sifter . . . . . * p. 249.
Levy, sifter . . . . . * p. 250.
Eldridge, sifter . . . . . * p. 251.
Robinson, sprinkler and duster . . . . . * p. 252.
Helm, brush and collector . . . . . * p. 253.
Ewing, brush and collector . . . . . * p. 255.
Heard, moth trap . . . . . * p. 262.
McQueen, trap-lantern . . . . . * p. 265.
Garrett, trap-lantern . . . . . * p. 266.
Duke, trap-lantern . . . . . * p. 267.
Stephens, trap-lantern . . . . . * p. 267.
Pitman, trap-lantern . . . . . * p. 268.
Dudley, trap-lantern . . . . . * p. 269.
Cranston, trap-lantern . . . . . * p. 270.
Pugh, trap-lantern . . . . . * p. 271.
Byrne & Strunk, trap-lantern . . . . . * p. 272.
Rigel, trap-lantern . . . . . * p. 273.
Stith, trap-lantern . . . . . * p. 274.

Couch'ing Nee'dle. (*Surgical.*) An instrument for depressing the opaque lens in cataract.

See Needles, Spuds, Spatulas, Curettes, etc., p. 27, Part II., *Tiemann's* "*Armamentarium Chirurgicum*."

Cou-lomb'. (*Electricity.*) A term for a unit in electricity. It was suggested at the Electrical Congress in Paris, 1881, that the name *coulomb* shall be given to the quantity of electricity defined by the condition that an *ampère* gives one *coulomb* per second. At latest advices the matter of nomenclature of units is yet unsettled.

Coun'ter-bal'ance Crane. One having a load on its frame opposite to the jib to partially counterbalance the object lifted and remove strain from the pintle, or prevent oversetting in the case of movable cranes; *j*, Fig. 1507, p. 643, "*Mech. Dict.*," is an instance. See also LOCOMOTIVE CRANE. See also BALANCE CRANE, Fig. 176, p. 66, *supra*.

Coun'ter-bore. A cylindrical counter-sink, usually made with a pin-drill.

Coun'ter Brace. A member in a frame which transmits strains in an opposite direction to a main-brace.

Coun'ter Cock. A faucet upon a counter for drawing beverages. See Fig. 707.

Coun'ter Gear. Driving gear, for lathes, for instance, attached to a ceiling or post, and connecting by band with the machine or machine-tool to be driven.

"*Engineer*" . . . . . * xlii. 258.
"*Scientific American*" . . . . . * xxxv. 342.

Coun'ter Pump. A pump beneath a counter for drawing liquids from barrels in a cellar beneath. See Fig. 708.

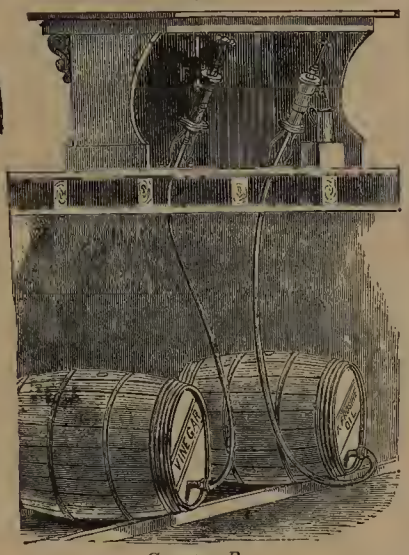
Coun'ter-sink. 1. (*Fire-arms.*) The recess in the rear of the chamber in which the rim of the cartridge fits.

2. (*Blacksmithing.*) A tool with a conical point to punch a tapering enlargement to a hole to receive the head of a screw.

Fig. 707.

Counter Cock.

Fig. 708.



Counter Pump.

3. (*Metal Working.*) A tool for chamfering the edge of a hole in metal. Fig. 709.

Fig. 709.

Countersink for Metal.

4. (*Wood Working.*) Barber's countersink, Fig. 710, is a gun-metal block which is screwed fast to the shank of the bit and carries an oblique steel cutter which chamfers the edge of the hole.

Fig. 711 is another countersink, with adjustable gage.

Fig. 710.

Countersink for Wood.

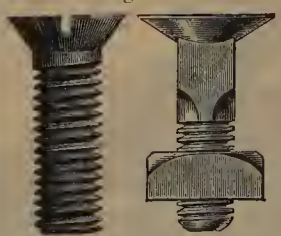
Fig. 711.

Countersink and Gage for Wood.

Welles . . . . . * "*Scientific American*," xxxiv. 119.

A countersunk head-bolt is one the head of which is buried in a depression in the object so as to be flush with its surface and not project.

Fig. 712.



Round Countersunk Head-screw.

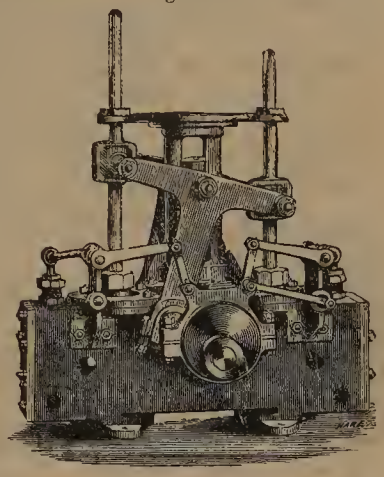
Square shank Countersunk Head-bolt.

Coup'led Steam En'gine. An arrangement in which two steam engines act in concert upon a single object; the term is more particularly applied, perhaps, to twin engines. The term *coupled* is perhaps a little astray in characterizing a grouping of a larger number, but the three-cylinder engine of Brotherhood, or the six-cylinder engine of West are *coupled*, in one permissible application of the word, *i. e.*, connected. This obtains in the *oryan coupler*, which connects *two or more* of the ranks of keys.

The instance adduced, however, refers to a *pair* only in the twin cylinder engine of Bernays, of London, in which the crank is rotated by the intervention of a triangular connecting rod, made practicable by an ingenious arrangement of eccentric and valve-gear.

The two upright double-acting cylinders are placed with sufficient space between them to receive the crank-shaft. The pistons are connected to one crank by means of a triangular connecting-rod, which causes them to move as if connected to two cranks at right angles to each other. The steam distribution in the two cylinders is governed by one ordinary eccentric and its connections, in a manner analagous to that by which the main crank governs the motions of the two pistons. Two eyes are provided on the eccentric-ring, carrying rods or levers, through which the valves are acted upon. The position of, and distance between, these eyes bear the same relation to the throw of the eccentric as the measurements of the main connecting-rod bear to the throw of the crank, reproducing on a smaller scale the triangular connection between the crank and the two piston-rods in the eccentric and valve-rods, and the steam is correctly distributed. The eccentric is loose on the shaft and is thrown to the right or left for the purpose of reversing the engine. The position of the crank-shaft in relation to the cylinders may be varied in height to suit any required purpose.

Fig. 713.



Coupled Steam Engine.

In this engine there is no dead point, for the reason that the two pistons can never be at the ends of their respective strokes at the same time, since they reach their limit of movement when the crank-pin passes a point in line closest to the pin of the triangle to which either engine-piston attaches.

"*Iron Age*" . . . . . * xxiv., July 10, p. 1.

Sweeney's Report, "*Paris Exposition* (1878) *Reports*," * iv. 382.

Coup'let. Two united, acting together, as of two elliptic springs, side by side, acting as a single spring. Coupled springs are shown on p. 483, "*Mech. Dict.*"

Triplet, *quadruplet*, etc., express still multiplied combinations of the same order.

Coup'ling. See under various heads, Compression Coupling; Car Coupling; Clutch, etc. See list on pp. 638, 639, "*Mech. Dict.*"

Locomotive coupling rods, *Rose*, * "*Sc. Am. Sup.*," 490.
Safety coupling chain . . . * *R. R. Gaz.*," xxiv. 428.

Coup'ling Valve. (*Railway.*) A valve contained in the case of the hose-coupling of an air-brake arrangement. See Brake-hose Coupling Valve.

Cou'pon Tick'et Ma-chine'. Hoe's modification of the cylinder press for this purpose prints railway coupon tickets at the rate of 1,200 per hour. The paper, laid by the operator sheet by sheet upon the feed table, is delivered automatically to the cylinder, printed, numbered, perforated, brought back and laid down printed side up upon the rack

under the eye of the attendant. The form and numbering wheels are on the same bed, and receive their ink from the same rollers. The impression cylinder gears into the bed, turning forward and backward with it, and, instead of fingers, has cords that run around in the spaces between the coupons. A numbering plate is arranged for each different spacing of coupons, so that no time is lost in adjusting the wheels.

Cou'pon Num'ber-ing Ma-chine'.

The French machine, for numbering coupons, checks, lottery tickets, stock-books, etc., is made by Pierron et Dehaitre, of Paris. It is worked by a pedal, and advances the sheet of paper at each stroke of the pedal a regulatable distance.

Cou-ronne' de Tasses. (*Electricity.*) The first cell battery. Invented by Volta, the author of the first pile, which the *Couronne* is said to have preceded. (*Niaudet.*) It consists of a series of glass cups placed in a circle, and each containing a zinc and a copper element, connected to the adjoining one of opposite polarity in the next cup.

Court Plas'ter.

Soak isinglass in a little warm water for 24 hours; evaporate nearly all the water by gentle heat, dissolve the residue in a little proof spirits of wine, and strain the whole through a piece of open linen. The strained mass should be a stiff jelly when cool. Stretch a piece of silk or sarsnet on a wooden frame, and fix it tight with tacks or packthread. Melt the jelly, and apply it to the silk thinly and evenly, with a badger-hair brush. A second coating must be applied when the first has dried. When both are dry, apply over the whole surface two or three coatings of balsam of Peru.

"*Scientific American*" . . . . . xl. 182; xlii. 105.

Cov'ered Sight. (*Fire-arms.*) One having the sight inclosed in a ring or tube. See BAR AND BEAD SIGHT; BEACH COMBINATION SIGHT; GLOBE SIGHT, etc.

Cove Plane. A molding plane, making a quarter round or scotia. See *j*, Fig. 3194, p. 1465, "*Mech. Dict.*"

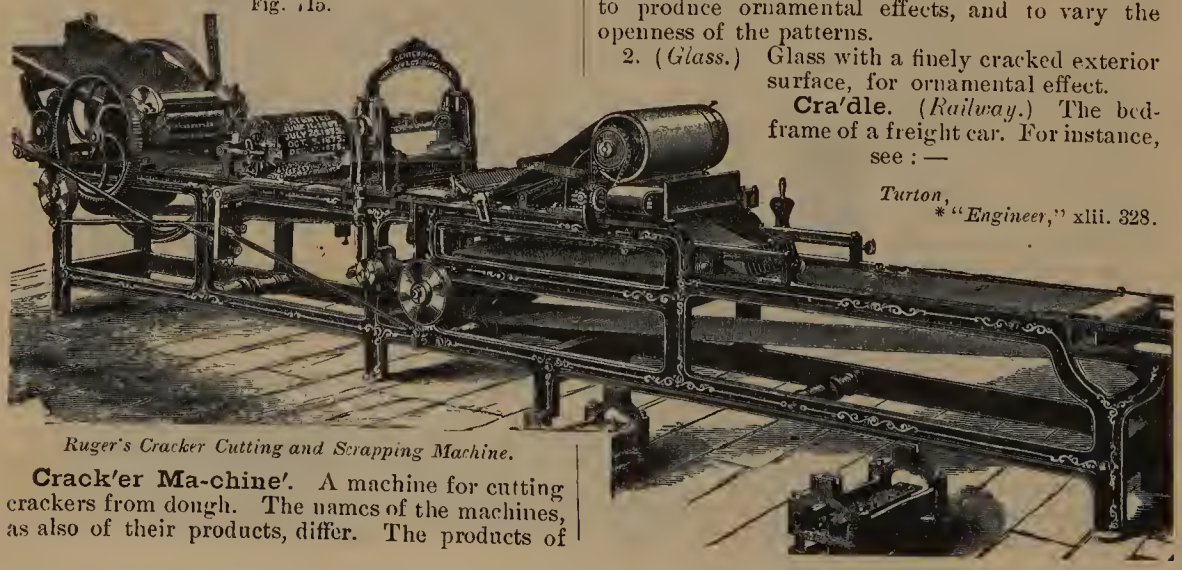
Fig. 714.

Cow-Horn Forceps.

Cow'-Horn For'ceps. (*Dentistry.*) Forceps for the extraction of molar roots when the crowns are decayed below the process.

They are made in pairs, right and left, for upper and for lower jaw.

Fig. 715.



Ruger's Cracker Cutting and Scrapping Machine.

Crack'er Ma-chine'. A machine for cutting crackers from dough. The names of the machines, as also of their products, differ. The products of the machines are usually known as crackers in this country, while they are called biscuit (*bis cuit*) in Europe. Lately, in this country, products called by the names oyster, butter, soda, milk, are known as crackers; while sweet goods, such as lemon, sugar, cream, tea, albert, etc., are called biscuits.

The machines, besides the generic names of biscuit or cracker machines, are known as *cutting machines* when they simply cut out the crackers from the blanket of dough, and *cutting and scrapping machines* when they automatically remove the scraps of dough from between the crackers. A *short cutting machine* is one with a short apron beyond the cutter, and may be a *two-peel machine* as holding on that portion of its apron, the *peel-end* of the machine, but two-peel lengths of crackers. A *three-peel machine* has an apron of one half greater length beyond the cutter.

The complete cracker machine rolls and dusts the dough, cuts into crackers, biscuits, cakes, and snaps, separates the cracker from the scraps, and places the work on pans.

The process of cracker-making by machinery is as follows: In the first place, the flour is run through a sifter, then put into troughs, where all the ingredients are mixed in by hand and left to stand until the chemical process is completed. The material is then run through the dough mixer, and from thence several times through the dough brake. It is piled up on a table, covered with cloth, and left to stand until it is properly proved, or gets light, then run again through the brake several times, being doubled over each time, and finally rolled out in a long strip the proper width for the machine. It is then placed on the hopper board of the machine, and goes through the rollers, where it is reduced to the proper thickness, falls on the apron or carrier, passes under a revolving brush, then to the cutter, which is changed to cut different shapes. After the crackers or biscuits are cut, the sheet of cut dough passes to the fingers and scrap apron, where the scrap is run over the upper apron, and the crackers pass below and drop into pans placed on the lower or third apron, and the pans are then placed in the oven and baked, which requires from 7 to 15 minutes, according to the kind of goods being baked. The largest set of machinery and oven will bake from 50 to 70 barrels of flour into crackers in ten hours.

See also Prof. *Horsford's* "*Report on Vienna Bread*," "*Vienna Exposition Reports*," vol. ii., § B.

Crack'ing Ma-chine'. (*Milling.*) A machine for fine-lining the surface of a millstone. The scores increase the grinding efficiency. See MILLSTONE DRESSING MACHINE.

Crack'le Ware. 1. (*Ceramics.*) Fr. *craquelle*. Ware, the enamel of which has a multitude of fine cracks, making a sort of reticulated surface. The art is Chinese; but as an actual effect, though not designedly so, many wares overbaked have a cracked glaze. The Chinese had the art of giving the crackle to definite portions of the surface, so as to produce ornamental effects, and to vary the openness of the patterns.

2. (*Glass.*) Glass with a finely cracked exterior surface, for ornamental effect.

Cra'dle. (*Railway.*) The bed-frame of a freight car. For instance, see: —

Turton, * "*Engineer*," xlii. 328.

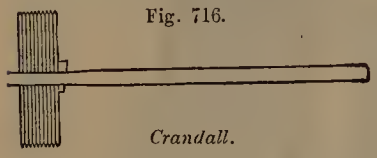
2. The infant's rocking crib.

Automatic, *Vandevort* . * "*Scientific American*," xxxiv. 99.
Attachment for bedsteads.
Robertson . . . . . * "*Scientific American*," xxxvi. 230

3. (*Mining.*) A suspended scaffolding used in shafts.

Cran'dall. (*Stone Working.*) A hammer made up of a gang of pointed steel bars occupying a slot 3″ × ⅜″ in the head of the bar. There are 10 bars in the gang, pointed at each end, ¼″ square, and held by a key. Used for putting a certain kind of dressing on ashlar. See list of tools under STONE WORKING.

Fig. 716.



Crandall.

Cran'daled Stone Work. (*Stone Cutting.*) An ashlar dressed by dotting its surface with rows of points, made with a *crandall*. When other rows at right angles to the first are introduced the stone is said to be *cross crandaled*.

Crane. A lifting apparatus with a neck or jib from a planted post. The points which distinguish the crane, derrick, winch, sheers, whin, gin, etc., respectively, are given on p. 63 and elsewhere, and a list occurs on pp. 1110, 1111, "*Mech. Dict.*"

The cranes for handling the steel ingots at the Krupp works are shown in Fig. 41, Appendix L, "*Ordnance Report*," 1877.

Austrian hydraulic cranes for handling heavy guns. *Ibid.*, Fig. 35.

The new crane of Woolwich, England, which has occupied four years in construction, exceeds 1800 tons in weight, and is capable of lifting 1200 tons.

See also RAILWAY CRANE; BALANCE CRANE.

See Automatic, *Watson*, Br. . * "*Engineer*," xlv. 53.
Crab bucket, *Wilson*, Br. . . * "*Engineer*," l. 279.
Locomotive, *Dubs & Co*, Br. . . * "*Engineering*," xxiii. 510.
Black, Hawthorne & Co., Br. * "*Engineering*," xxii. 312.
Appleby . . . . . * "*Sc. Amer.*," xxxiv. 147.
Coaling locomotives, *Wendt*, Ger. * "*Engineer*," xlix. 120.
Portable, *Wilson*, Br. . . . . * "*Engineer*," l. 279.
70-ton, *Taylor*, Dundee, Br. . . * "*Sc. Am.*," Nov. 6, 1875.
100-ton, } Creusot, Fr. . . . . * "*Engineer*," xlv. 335.
160-ton, } Creusot, Fr. . . . . * "*Sc. Amer. Sup.*," 2051.
Traveling (Belgium). . . . . * "*Sc. Amer. Sup.*," 744.
Traveling . . . . . * "*Sc. Amer. Sup.*," 653.
Steam, Paris Exposition . . . * "*Exposition de Paris*," No. 54, Mar., 1878.

Crane Steel'yard. One suspended from the jib of a crane to weigh objects in transitu. *Romaine en l'air.*

Fig. 717.

French Crane Steelyard.

Cra'ni-o-clast (*Surgical.*) A forceps for crushing the fetal skull.

Simpson's, Fig. 532, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Cra'ni-ot'o-my For'ceps. (*Surgical.*) An alligator forceps for crushing the fetal skull in cases of obstructed labor.

Fig. 718

Dr Meigs' Craniotomy Forceps.

Crank. See the following references: —

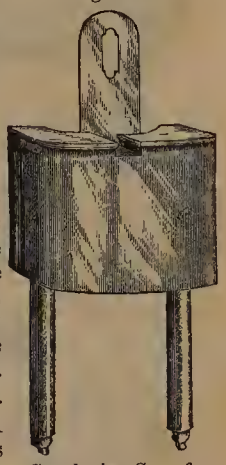
Axles, modes of forging, *McLean* * "*Iron Age*," xxiv, Sept. 25, p. 1.
Bending appa. hyd., *Clarke*, Br. * "*Engineer*," xlv. 438.
Pin driver, *Shaffer* . . . . . * "*Am. Manuf.*," May 23, 1879, p. 13.
Pin turner, *Webb*, Br. . . . . * "*Engineering*," xxviii. 260.
Shaft, "Trenton," . . . . . * "*Sc. Amer. Sup.*," 415.
Shaft repair, "Colima" . . . * "*Sc. Amer. Sup.*," 491.

Crank and Fly'wheel Steam Pump. A form of steam pump, as distinct from the *direct acting*.

A crank shaft and rods is interposed between the steam cylinder and pump cylinder.

Crank'-pin Cup. A lubricator for the crank of an engine. The instance in Fig. 719 is one for a propeller. The great and constant strain renders special provision necessary; as it was aforetime with the paddle-wheel shafts, which lifted at each revolution a quantity of oil and poured it on the journal.

Fig. 719.



Crank-pin Cup for Propeller Engine.

Crank'-pin Jack. An application of the hydraulic press to the pressing on or off of the crank pins of locomotives. The press is supported on a barrow, and is shown as supported by tie bars from the wheel in the act of pressing in a crank-pin.

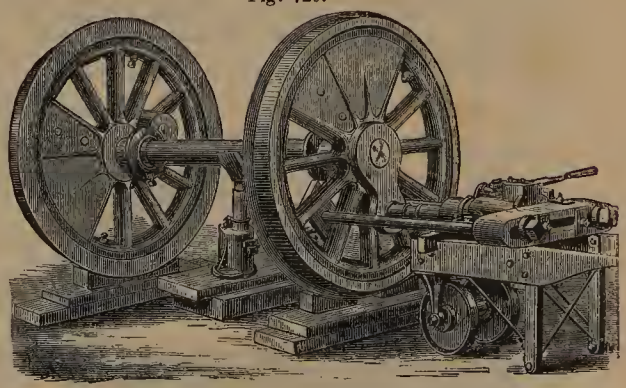
"*Railroad Gazette*" . . * xxi. 550.

Crank'-pin Turn'er. A machine for turning crank-pins in position, and while the wheels are under the engine.

It is fastened by means of scroll and self-centering jaws at one end, to the collar of the crank pin, upon which there is no wear. It is then clamped in position by bolts passing through the spokes of the driver. The tail-stock center is then run up, and if the pin is not bent will fit in the old center, and the machine is ready to operate. The cutter is driven and fed either way by the crank and intermediate gearing which gives motion to the screw. The cutter is bent and fastened by a set screw in the extreme end of the cutter bar.

"*Iron Age*," . . . . . * xx., Nov. 29, p. 1.
"*Mining & Scientific Press*" . . . . * xxxvi. 273.

Fig. 720.



Dudgeon's Crank-pin Jack.

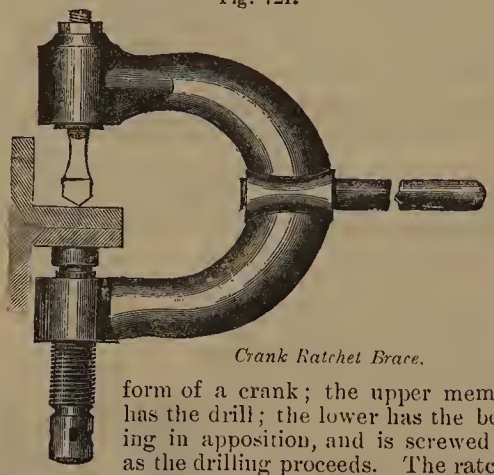
Crank Pla'ner. A metal-planing machine, in which the tool stock is moved on ways above the bed by pitman attachment to a wrist on a crank wheel.

A special machine, for planing cranks, having a short and rapid or variable stroke, is made by Hull & Belden. It has the usual horizontal bed on track; 12″ at full stroke, and Whitworth quick return motion. Cross and angular, or cross and down feed, as desired. The screw runs the length

of the bed, enabling the operator to change position of stroke.

Crank Ratch'et Brace. A ratchet brace in

Fig. 721.



Crank Ratchet Brace.

form of a crank; the upper member has the drill; the lower has the bearing in apposition, and is screwed up as the drilling proceeds. The ratchet is in the upper head, so that the drill moves only during the effective stroke. See RATCHET BRACE.

Crate Hasp. Hinged hasp and staple for securing the lids of boxes and crates.

Fig. 722.

Crate Hinge.

Cray'on Cut'ter. For pointing crayons: two circular rasps on a lathe arbor set obliquely so that their interval gives the required chamfer to the crayon point. The *chamfering machine* for wood, though on a very much larger scale, may give an idea of the apposition of the rasps.

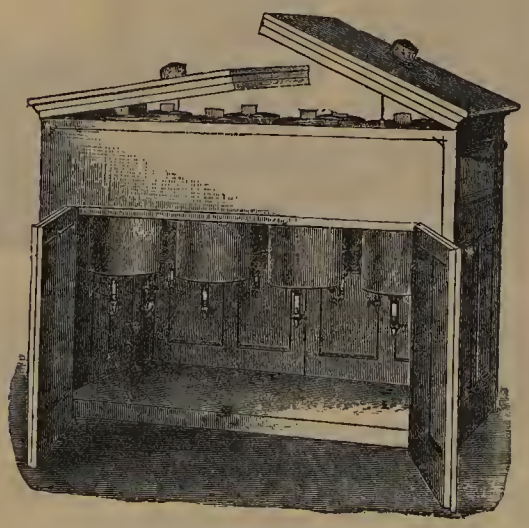
Cray'on Mold. A hinged mold in two parts, each containing a series of semi-circular depressions, the corresponding parts of each, when the mold is closed, form cylinders, in which the crayon material is molded.

Cream'e-ry. An apparatus or closet, with facilities for cooling or heating, in which to place milk jars under favorable conditions for cream-raising.

The *Ferguson* bureau creamery is a large press with shelves for cream, inclosing doors, and with a cupboard above for ice, and one below for the heater which is used in winter. U. S. Patent, August 22, 1876.

The *Moseley* creamery has deep cans suspended in a closet,

Fig. 723.

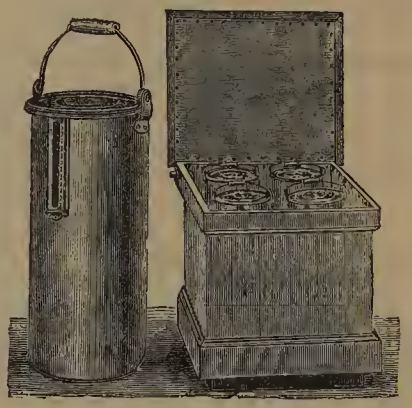


Moseley Creamery.

and with means for drawing off the milk beneath, in lieu of skimming the cream.

The *Scoville* creamery has a wooden box designed to be set

Fig. 724.



Scoville Creamery.

in the ground, and has pipes for entry and discharge of spring water. The deep tin pails have cream gages in inches at the sides.

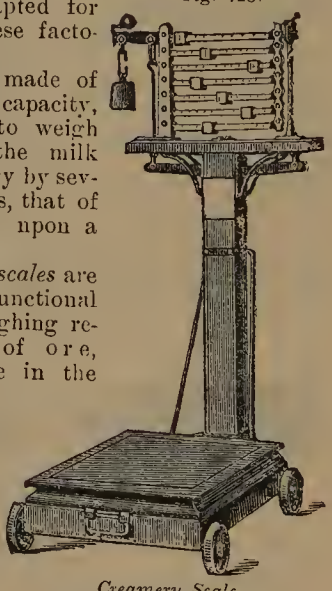
Scovill Creamery . . . . * "*American Inventor*," iv. 173.
Cream raiser, *Plumb* . . . * "*Sc. American*," xli. 7.
Weldon . . . . . * "*Sc. American*," xl. 134.

Cream Ware. (*Ceramics.*) *a.* A name given by Wedgwood to a fine, light, yellow paste, invented by him in 1762. He also called it *queensware*, — a compliment to Queen Charlotte.

b. The ordinary *queensware* of the present is *stone ware.*

Cream'e-ry Scale. A scale with several beams, each having a sliding poise, specially adapted for creameries and cheese factories.

Fig. 725.



Creamery Scale.

Such scales are made of from 600 to 1,000 lbs. capacity, and are intended to weigh at a single draft the milk brought to the factory by several different persons, that of each being weighed upon a separate beam.

Furnace charging scales are made with the same functional arrangement for weighing respective quantities of ore, coke, and limestone in the same charge.

Creep'er. A spiral inside a revolving cylindrical grain screen to pass the grain towards the discharge end. A conveyor or a spiral on the inner surface.

Cre-ma'ting Car. One for burning bodies *in transitu* to the Columbaria, disposing of the corpse *en route. Decrescit eundo. Kuborn & Jacques.*

Furnace . . . . . "*Sc. Amer. Sup.*," 247.
Temple . . . . . * "*Sc. Amer.*," xxxvi. 49.
Turner, Temple at Woking, Br. * "*Technologiste*," xli. 367.
In Japan . . . . . * "*Technologiste*," xli. 108.
Lissagaray, superheating . . . * "*Technologiste*," xli. 496.
Moist system . . . . . * "*Technologiste*," xli. 508.

Cre-mom'e-ter. A specific gravity instrument of the hydrometer form, invented by Chevalier. The scale shows percentages in mixtures of water and pure milk.

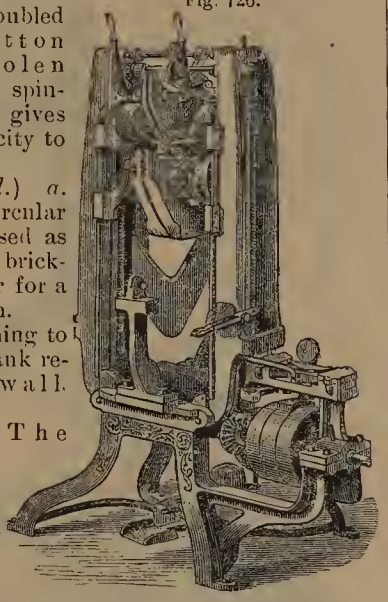
Cre'o-so-ting Ap'pa-ra'tus. Apparatus for saturating timber with a solution, to prevent decay.

Bethel's English Patent, 1838.
The works of E. R. Andrews, South Boston, Mass., under Hayford's patent method of creosoting timber, are shown in "*Railroad Gazette*" . . . . . * xxiv. 267.
See also cut 7337, p. 2811, "*Mech. Dict.*"
"*Iron Age*," . . . . . xx., Dec. 27, p. 7.
See "*Treatise on Dry Rot in Timber*," by T. A. Britton, Spon.

Crest'ing. The ornaments or finials on the summits of iron posts, or along the rails of an iron fence, a balustrade, or on the crest of a roof.

Cre-tonne'. (*Fabric.*) A French dress goods woven on a taffeta loom: it has a doubled and twisted cotton warp, and a woolen weft. The close spinning of the warp gives a peculiar elasticity to the goods.

Fig. 726.



Jamison's Crimping Machine.

Crib. (*Add.*) *a.* (*Mining.*) A circular frame of wood, used as a foundation for bricking in a shaft, or for a pneumatic caisson.

b. A timber lining to a shaft, or the plank revetment of a wall. *Cribbing.*

c. (*Fishing.*) The bowl or pound of a POUND NET, which see.

Crib Break'-wa-ter. One made of logs or timbers notched into each other in the manner of a log house. See instance in Breakwater at Michigan City, Ind.

"*Report of Chief of Engineers, U. S. Army*," 1879, * ii., page 1588.

Crib Dam. One made log-house fashion, supporting a bank of earth which holds the water.

See plans and sections of a dam at New Harmony Cut-off, on the Wabash River. "*Report of Chief of Engineers, U. S. Army*," 1879, * ii., 1440.
Kanawha River, *Ibid.*, 1878, * ii. 467.
Rock Island, Ill. "*Report of Chief of Ordnance, U. S. A.*," 1877, * 354, and Plate XII.
Fox River, Wis. *Ibid.*, 1876, vol. ii., Part II. Appendix x. 4, p. 416.

Crib Muz'zle. (*Manége.*) A muzzle used to correct the equine habit of cribbing.

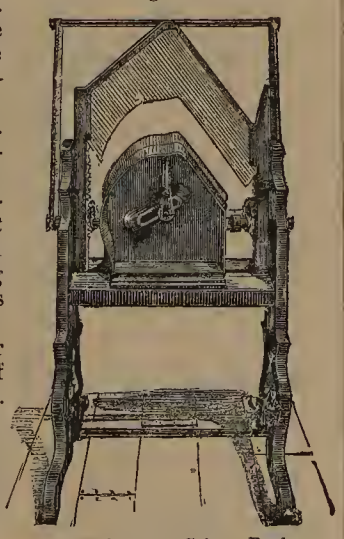
Crimp Brake. See CRIMPING MACHINE.

Crimp'ing Ma-chine'. 1. (*Sheet Metal Working.*) A machine for crimping the tops and bottoms on can bodies.

2. A machine for crimping the ends of stationary blind slats. An effective machine swages the ends of 150 slats per minute.

3. A machine for crimping uppers of boots and bootees. The piece of leather is forced over a curve-edged board to give it shape.

Fig. 727.



Makepeace Crimp Brake.

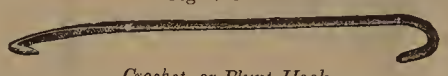
The *Jamison* machine, Fig. 726, has a pair of descending cheeks which slip over the sharp edge of the bent former, crowding the leather over the latter and pressing it at all points, to prevent wrinkles, and to produce regular thickness. It is driven by power.

The *Makepeace* machine, Fig. 727, is driven by hand, and the action is the reverse of the other machine, the bent former descending and crowding the leather into the slit between the two cheeks, which press forcibly against it and smooth out all wrinkles.

The French *cambreuse*, of *Pilon*, Mans, France, operates in yet another way, the jaws ascending to press the leather over the suspended and rigid former. It is specially intended for making upper and back in one piece, and joining at the back (*bottes d'officier, dites "jointure derrière"*).

Croch'et. (*Surgical.*) An obstetric hook for withdrawing the fetus.

Fig. 728.



Crochet, or Blunt Hook.

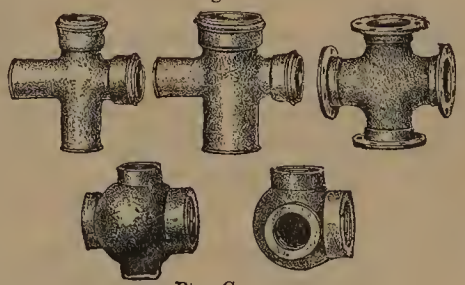
Crooke's Mill. Another name for the radiometer of Professor Crookc. See RADIOMETER.

"*Manufacturer and Builder*" . . . * ix. 229, 241.

Crop'per. A powerful hand machine for shearing off bolts or rod iron. It has holes of varying diameters for different sizes of iron, and the shears operates by a long lever.

Cross. A quadrangular pipe coupling.

Fig 729.



Pipe Crosses.

a. Cross; two bell ends.
b. Reducing cross; two bell ends.
c. Four-flanged cross.
d. Reducing globe cross.
e. Corner-fitting globe cross.

Cross'-bar. (*Fire-arms.*) The small bar in a break-joint breech-loader, which, when the barrels are falling, presses out the extractor.

Cross'cut Saw. *Hand.* Crosscut saws are one or two-handled, see p. 649, "*Mech. Dict.*"

Power. The cross-cutting sawing machine, for the woods, is usually a *drag* saw, of which one instance is given in Fig. 1522, p. 649, "*Mech. Dict.*"
Cross-cutting machines for the factory are described under CUTTING-OFF SAW, which see.
See also BRACKET CUTTING-OFF SAW.

Cross File. One having curved faces unequally convex.

Cross-gain'ing Ma-chine'. A machine for cutting gains or slots in timbers crosswise of the grain or stuff. See Fig. 2144, p. 935, "*Mech. Dict.*"

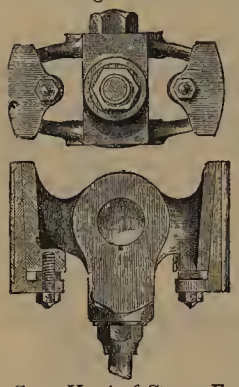
Cross Head. 1. The cross-bar on the end of a connecting-rod or piston, having gibs on each side to fit the slides.

In the instance given, the cross-head has adjustable gibs on each side, turned to fit the slides, which are cast solidly in the frame, and bored out exactly in line with the cylinder. This permits it to freely turn on its axis, and in connection with the adjustable boxes in the connecting-rod, allows a perfect self-adjustment to the line of the crank-pin. Fig. 730.

2. (*a.*) A cruciform-shaped four-handled bar, at the upper end of a drill-rod or earth-auger, and by which the latter is turned; used for drilling or sounding wells or shafts. Fig. 731.

(*b.*) A sleeve with hooks for the suspension tackle of a well-drill. Fig. 731.

Fig. 730.



Cross Head of Steam Engine.

Fig. 731.

Well Drilling Cross Heads.

Cross-head, locomotive, *Alexander.* * "*Sc. Am.*," xxxv. 246.

Cross-peen' Ham'mer. One the *peen* of which is crosswise of the direction of the handle.

Cross Rais'ing Ma-chine'. A machine for cross raising the nap of cloth.

Fig. 732.

Cross-peen Hammer.

In cotton machinery a machine for this purpose carries bands of cards by a circular motion in one direction over the face of the cloth.

In Delamare & Chandelier's machine (Rouen, France), the cloth is carried by and is stretched across a pair of rollers; over the suspended part of the cloth, rollers covered with metallic cards revolve in a direction at right angles to that of the traverse of the fabric; these rollers have at the same time a to-and-fro motion across the piece, so as to insure their action upon the whole width of the piece.

"*Bulletin of the Industrial Society of Rouen*," reported in the "*Textile Manufacturer*" and "*Scientific American Sup.*," * 2581.

Cross Tube Boil'er. In the usual vertical form, this boiler has one or more horizontal cross tubes, 6″ to 8″ in diameter, placed across the fire-box. See VERTICAL BOILER. The water circulates in these while the heated gases pass around them, and are then conducted by a straight flue to the chimney.

Fig. 733.

Appleby's Cross Tube Boiler. (British.)

Fig. 733 is another form in which the tubes are smaller and more numerous. The upper and lower portions of the shell are connected by flanged joints bolted together, and the uptake is secured to the crown-plate in a similar manner. The lower part of the fire-box is circular, but above the fire-door it is worked into a square form to receive a square upper box, into which are fitted a number of parallel tubes of such diameter as may be most suitable for the size of boiler and the heating surface required. These traverse horizontally the flame space, the volatile products passing upward among the tubes and escaping by the vertical central flue. The tubes connect the water-space which forms a jacket around the fire-box and flue.

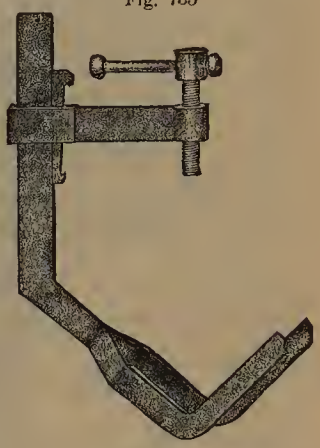
Fig. 734.

Cross Valve.

Cross Valve. A valve at the crossing or rectangular divarication of a pipe. Fig. 734.

Croup Ket'tle. (*Surgical.*) A small kettle and alcohol lamp for quickly raising a steam for inhalation in cases of croup.

Fig. 735



Crow.

Crow. An implement for gripping beneath a main and holding a tapping-brace above it, when tapping street mains.

Crowd'ed-teeth For'ceps. (*Dentistry.*) A narrow-beaked full-curved forceps for removing superfluous teeth which mar the symmetry of the row.

Fig. 736.

Crowded Teeth Forceps.

Crown Arch. An arched plate over a furnace supporting the crown sheet.

Darby's crown-arch for locomotive fire-boxes replaces the ordinary crown bars by an arched plate, 5–16″ thick, with a rise in the center of 6½″. This is riveted at each end of the crown sheet and then stayed in the ordinary way between the ends, with 7–8″ bolts spaced 4½″ from center to center. Angle iron is riveted to the top, to which suitable sling stays are attached.

"*Railroad Gazette*" . . . . . * xxii. 356.

Crown Bar. (*Locomotive.*) One of the bars supporting the crown sheet of a boiler.

Crown Poun'cing Ma-chine'. (*Hat Making.*) A machine for pouncing the crowns of hats. The name is derived from pounce or fine sand, and the operation consists in sand-papering the surface of the hat body, or the hat after it has been blocked. See POUNCING MACHINE.

Crown Tel'e-phone. An instrument consisting of two magneto-electric crown telephones united. Each of these consists of a coil, diaphragm of iron, and six permanent magnets, which latter are placed with their like poles together in the center of the coil, the other poles being bent round, into contact with the periphery of the diaphragm. Thus the diaphragm forms the other pole to that within the coil, and in this way the magnetic field is intensified. In the double-crown form the two diaphragms are separated by an air-chamber, with a mouth-piece or orifice, into which a person speaks. The coils are so connected in circuit that the vocal currents generated in each coil strengthen one another. — *Phelps.*

"*Telegraphic Journal*," vi. 399. See also *Hinkley's, Ibid.*, * vi. 476.

Crown Tre-phine'. (*Surgical.*) A crown saw used in removing sections of the cranium. *b*, Fig. 6647, p. 2624, "*Mech. Dict.*"

Cro'zing Ma-chine'. A machine for making the grooves in casks to receive the edges of the heads.

The work when done by machinery is usually combined with chamfering and howeling and sometimes with leveling.

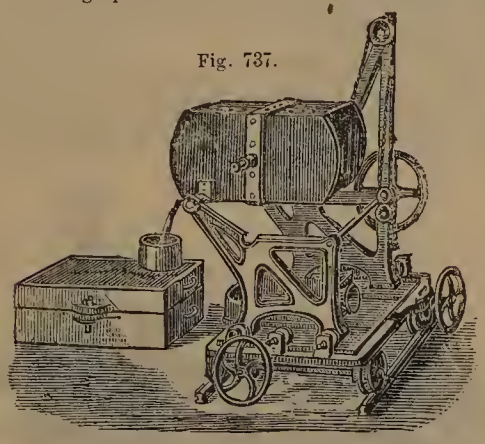
See BARREL CROZING MACHINE; CHAMFERING MACHINE; see list under BARREL MACHINERY.

"*Manufacturer & Builder*," . . . . * xi 55.
Steel & Munson's machine . . . . Patent Nos. 160, 966.

Cru'ci-ble Fur'nace. One of the most notable departures in crucible furnaces is that of M. Piat, of Paris, in which the crucible and furnace are moved together to the place where the casting is to be made.

The crucible is fixed within the furnace wall, the weight of both coming upon trunnions when they are lifted from the

Fig. 737.

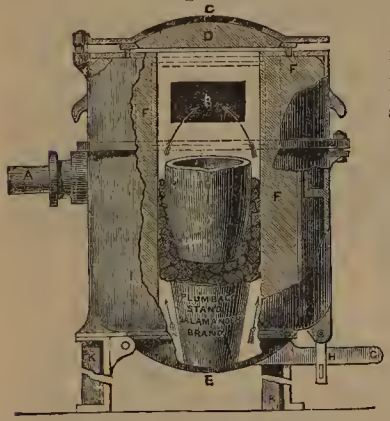


Piat's Crucible Furnace on Movable Carriage.

lower furnace wall. The space between the crucible and the refractory lining of the furnace wall is filled with combustible, the ashes from which fall through holes in the furnace into the ash-pit when the crucible is over the draft. It is moved on a car or by crane to the place of casting, and tipped on its trunnions to pour the metal.

Fletcher's annular hot-air furnace for melting metals has no fire-bars, but a dished bottom secured by a lever. The draft from the fan is admitted at *A*, and courses through the ducts around the fire-clay lining *F*. The crucible stands on a fire-clay pillar and is surrounded by fuel, the gaseous products escape at *B*. *C* is the hinged cover or lid with fire-clay lining *D*. *E* is the hinged bottom with lever *G* and detent *H*. *I* is the outer case or lining, *K* the legs of the stand.

Fig. 738.



Hot-air Crucible Furnace.

The French *calebasse*, a form of crucible used in Europe in melting quantities of iron below the usual duty of a cupola, is shown in *Laboulaye's* "*Dictionnaire*," etc., i., Figs. 355-357, ed. 1877, article "*Calebasse.*"

On Crucibles, *Kirk* . . "*Iron Age*," xxi., May 9, p. 3.
Furnace . . . . . * "*Sc. American*," xlii. 35.
Annular, *Fletcher*, Br. . * "*Engineer*," xlvi. 74.
* "*Sc. American Sup.*," 2271.
Tilting, *Piat* . . . . "*Iron Age*," xxii., Aug. 29, p 9.
* "*Sc. American Sup.*," 2111.
Making crucibles . . . * "*Sc. American*," xxxvii. 242.

Cru'ci-ble Steel. (*Metallurgy.*) Steel made in crucibles. The Indian plan for making wootz. The invention of *Huntsman*, of Sheffield, England. Cast steel.

Cruik'shank Bat'te-ry. (*Electricity.*) The original trough battery invented by Cruikshank. The partitions forming the cells in the trough were composed of two plates of copper and zinc soldered together and the spaces filled with acidulated water.

Niaudet, Am. trans. . . . . * p. 14.

Crush'er. A machine for degrading rock, fossil manure, etc. See STONE CRUSHER, DISINTEGRATOR, etc.

See *Blake* . . . . . * "*Min. & Sc. Press*," xxxiv. 257.
(New) . . . . . * "*Sc. American*," xlii. 210.
Stone, ore, etc., *Blake* . . * "*Sc. American*," xlii. 210.
Mill, *Walker* . . . . . * "*Sc. American*," xxxix. 341.
Baugh . . . . . * "*Eng. & Min. J.*," Nov. 4, 1876.

Crush'er Gage. A registering instrument exposed in the bore of a gun to measure the pressure developed by the explosion of a charge. See PIEZOMETER; CUTTER.

To illustrate: a 16-ton steel gun of Vavasseur, fired at Woolwich, had a projectile of 400 pounds, 70 pounds of pebble powder made up into a cartridge 25″ long. The charge being fired at the center, the crusher gage at the rear of the charge showed a pressure of 21 tons to the square inch, the gage at the base of the shot, 18 tons; initial velocity of the shot 1412′ per second. The charge fired at the base, the gage gave pressures of 45.1 and 50.1 tons respectively at the rear of the charge and base of the shot.

"*Engineer*" . . . . . Sept. 16, 1870.
"*Scientific American*" . . . . . xl. 133.
"*Scientific American*" . . . . . xlii. 393.

Cry'o-lite. Greek *kryos*, "ice," *lithos*, "stone," from its beautiful snowy appearance. This mineral is a double fluoride of sodium and aluminium, and has long been known in cabinets, and to chemists, but has but lately assumed commercial importance.

It has been found at Miask, in the Ural Mountains, in limited amounts, but its great source is the west coast of Greenland, where it is procured in immense quantities at Ivigtout, on Arsuk Fiord, between Julian's Hope and Frederick's. The main deposit here forms a mass, according to reliable authority, 600′ in length, and 200′ in width, and descending to an unknown depth.

The mineral occurs in partially translucent masses of a snowy white color, having very much the appearance of snow ice, whence its name. It is frequently associated with galena, blende, iron and copper pyrites, and spathic iron ore.

In 1850, Julius Thomsen, a Danish chemist, discovered a cheap method of rendering cryolite available for the manufacture of soda and alum.

The employment of Greenland cryolite in the manufacture of aluminium is attributed to Rose, of Berlin. It is also used in the later Deville aluminium process. See ALUMINIUM.

Cryolite is largely used by the Pennsylvania Salt Manufacturing Company at Natrona, Penn., and a number of cryolite products are there made.

It has been used also in making what has been variously called "cryolite glass," or "hard porcelain," a vitreous semi-translucent material, well fitted for some purposes. The proportions used are about, cryolite 1, sand 3; the resulting glass is easily molded and cut, and is noted for its tenacity. See CAST PORCELAIN.

For the milky variety a mixture is employed consisting of the following materials: One part of oxide of zinc, four parts of cryolite, and ten parts of sand, fused in a common pipe-clay crucible, developing a large amount of fluosilicic acid. The pipe-clay is, however, not much attacked by it. This development continues throughout the fusion, and even after it, during the working, to a small extent.

"The utilization of cryolite depends upon Thomsen's observation, that the mineral may be completely decomposed by treatment with lime, either in the wet or dry way, the products of this treatment being, generally speaking, caustic soda, aluminate of sodium, and fluoride of calcium. The ease with which this decomposition can be effected, and the notable percentage (35 per cent.) of soda which the mineral thus yields, renders it a very valuable commercial source of soda and its compounds. The alumina which it contains is used for the production of alum salts.

"Where the dry process is employed, the cryolite is dried, ground to a fine powder, and mixed with slaked lime, or

with pulverized chalk, in such proportions that for each equivalent of cryolite there shall be about six of lime. This mixture is then calcined in a furnace at a dull red heat, — not sufficient, however, to fuse it. After a charge has cooled, it is lixiviated, and the dissolved soda and aluminate of soda drawn off from the insoluble residue (fluoride of calcium). By passing carbonic acid gas (obtained from the combustion of coke) through this solution, the soda is converted into the carbonate, and the alumina is precipitated.

"In the wet process, the cryolite is boiled with milk of lime; and according to the proportions of lime employed, the resultant products are caustic soda and aluminate of sodium, or, where the proportion of lime is greater, caustic soda and aluminate of lime, fluoride of calcium being formed of course in both cases. The latter process gives all the soda of the cryolite in the caustic state, the only operation required being evaporation to dryness.

"The aluminate of sodium produced in the operation above described is used in the manufacture of soaps, in place of soda and potash lye. It is completely decomposed by passing carbonic acid gas through it, and the resulting alumina which is precipitated is converted into sulphate of aluminium and alum. The fluoride of calcium, which is a by-product of the treatment of cryolite, is used as a flux in the reduction of gold, iron, and other metals." — *Polytechnic Review.*

See the following references: —

"*Iron Age*," . . . . . xx., Sept. 13, p. 7.
"*Scientific American*," . . . . xxxv. 375.
"*Scientific American Sup.*," (uses). 990.
"*Manufacturer & Builder*," . . . ix. 215; xii. 192, 256.
"*Mining & Scientific Press*" . . xxxviii. 177.

Cryp'to-graph. An apparatus designed for secret correspondence.

A metallic plate is perforated with holes.

A tablet is marked off with squares. A plate of the same size and rulings is perforated at a number of the squares in an irregular manner. The plate being laid on the tablet, the message is written, the letters in the consecutive holes as they may run in the line and succeeding lines. The plate is then rotated one quarter round and the message continued, so on for the other two positions of the plate. The result is a confused lot of letters with breaks of continuity. It may be read by a similarly perforated plate laid on the paper, and moved successively as by the writer.

Crys'tal. (*Glass.*) Another name for *flint glass;* a silicate with a base (usually) of lead and potash; but the Bohemian has a base of lime and potash.

Cube Pow'der. Large grained gunpowder for slow burning in large charges in heavy ordnance. *Prismatic powder.*

"*Engineer*" . . . Sept. 16, 1870; March 17, 1876, p. 185.

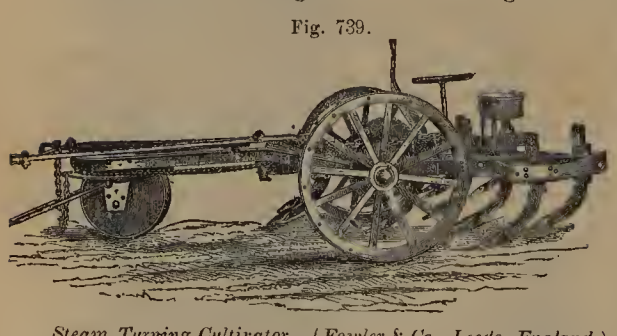
Cu'bic Foot Meas'u-rer. An apparatus used in estimating and testing gas.

Goodwin . * "*Am. Gas-light Journal*," July 3, 1876, p. 4.

Cuff Frame. A knitting machine specially constructed for knitting cuffs for cardigan jackets and underwear. Campbell & Clute.

Cul'ti-va'tor. Fig. 739 is the turning cultivator, adapted to be worked by all systems of steam-plow machinery. It may carry from 5 to 13 tines, and rests on 3 wheels, one of which is the steering-wheel. The axle of the two hind-wheels is cranked, so that by its being turned the frame is raised or lowered, and by this means the penetration of the tines adjusted.

Fig. 739.



Steam Turning Cultivator. (*Fowler & Co., Leeds, England.*)

The long end of a draft bar or turning lever is provided with two arms to which the two ends of the rope are attached. The arms are set at an angle for keeping the tail rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame considerably behind the steering-wheel. This position of the draft-stud gives the necessary liberty and power to the steering-wheel and enables it to lead the implement at almost any angle out of the line of the pulling-rope.

On the short end of the turning-lever is a chain communicating with a quadrant on the crank-axle, and as the lever is pulled round, the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

The plan of operation is as follows: As soon as the cultivator is brought up to the headland, the reverse pull brings the lever around, turns the quadrant, rotates the bent axle, and lifts the tines out of the ground, in which position the cultivator frame is held up by a catch; when lifted the required height, the lever strikes against a stop, and the implement turns into new ground. The man, who never leaves his seat, releases the catch, the tines drop into the ground, and the implement is re-drawn across the field.

This, after the plow, is the most important and efficient implement of the series. Its size is only limited by the power of the engines, which are thus used up to their capability. It pulverizes the soil, working steadily to a uniform depth. The largest machines require but one man in attendance upon them.

Fig. 740 shows the steam cultivator for very deep working, say 16″. It may have 3 or 5 tines, which lift the soil and leave it loose. It has a strong flanged steel frame, shares of various widths from 2″ to 13″, and oblique wings to lift the soil. The tines rock on the frame, so that when the implement is to return across the field the points at work are slightly depressed and the hinder points raised.

Fig. 740.

Double Action Steam Cultivator. (*Howard, Bedford, England.*)

The *Deere* walking cultivator is shown in Fig. 741. It has the usual two double-shovel plows, attached to a two-wheeled frame with a tongue alongside of which are hitched the two horses which travel on the respective sides of the row under cultivation.

It is peculiarly open and clear, not obstructing the view of the crop, and the spring coupling lifts the plows on their pivots to any adjustable extent, so that a part of the weight is carried and they bear with any desired force upon the ground to turn a moderate furrow when the corn is small, or a deeper one when the crop is more matured. The pitch of the shovels is also adjustable by vertical adjustment of the end of the beams. The distance apart of the shovels is adjustable. One of the wheels is broken to expose the parts more fully.

Cultivators are classed as: —

Ordinary,	Disk,
Wheeled,	Walking,
Rotary,	Riding,
Straddle-row,	Vineyard.
Parallel.	Expanding.

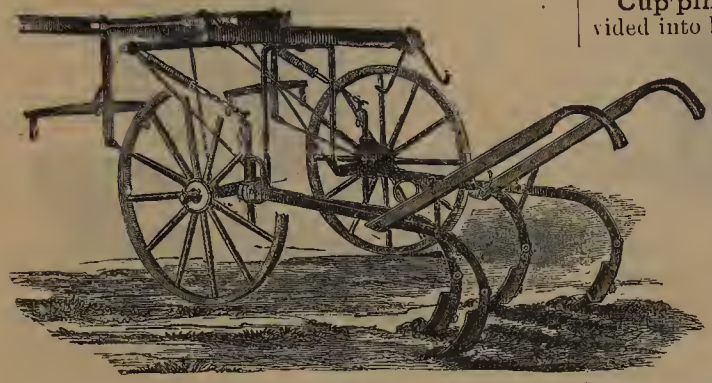
Besides these characteristic names, several of which apply to single implements, as for instance the popular Western implement, the *Walking*, *Straddle Row*, *Wheeled Cultivator*, there are several other classes of implements which naturally fall under so general a caption as cultivator: such are known as *scarifiers*, *extirpators*, *shovel plows*, *horse-hoes*, etc. Which see in "*Mech. Dict.*," *et infra.*

The author's report on Class 76 at the Paris Exposition shows the following ("*Paris Exposition* (1878) *Reports*," vol. v., pp. 90-93): —

French horse-hoes.
French scarifiers.
English lever cultivator.
French extirpator.
"Peerless" cultivator, U. S., American riding cultivator.

English Five-tine horse-hoe and grubber.
Also: French vineyard cultivators, Figs. 221-231, pp. 216-240.
English steam cultivators, Figs. 84-88, pp. 83-86. *Ibid.*

Fig. 741.



Walking Cultivator.

Cultivator for beets, "*Dept. Agric. Spec. Rept.*," No. 28, Plates V., V'.
French, *Bertel.*
Cultivator with saws, *Stone* * "*Scientific Amer.*," xxxv. 4.

Cul'ti-va'tor Plow. Fig. 742 shows an English single-row horse-hoe or cultivator plow, made for cultivating root crops in drills. The implements can be adapted either for flat or ridge cultivation.

The share with lateral wings precedes, and is followed by cultivator shares, these by harrow tines, and lastly by a chain harrow.

Fig 742.

Cultivator Plow. (*Corbett & Peale, England.*)

Cul'ti-va'tor-point Bolt. A bolt of peculiar form used to connect the shares of cultivators with their standards or sheths. The head has two flat sides and two straight bevels, as shown in Fig. 743, to adapt it to the two-sided countersink of the shovel.

Fig. 743.

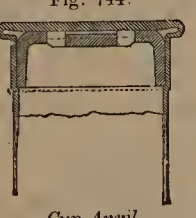
Cultivator-point Bolt.

Cup. An oil cup. See CRANK CUP; OIL CUP; LUBRICATOR.

Cup An'vil. A cup-shaped reinforce inside the head of a cartridge to strengthen it. Fig. 744. See also DISK ANVIL, U. S. Ordnance "*Report on 'Metallic Cartridges,'*" 1873, Plates XXIX., XXX.

Cup Leath'er. A leather to fasten around a pump plunger or bucket. Cups are made like sleeves for buckets and with solid bottoms for plungers.

Fig. 744.



Cup Anvil.

Quilted cups are used for hot liquors.

Cu'po-la. A melting furnace in a foundry. See p. 658, "*Mech. Dict.*"

And tuyere, *Lawrence.*
* "*Iron Age*," xviii., Oct. 5, p. 1.
Return flue, *McKenzie*, straight. * "*Iron Age*," xx., Oct. 18, p. 16; * xx., Nov. 8, 19.
Furnace, *Voisin*, Fr. . . . . * "*Iron Age*," xvii., May 18, p. 5.

Cup'ped Sound. (*Surgical.*) A urethral syringe with cup-like depressions on its surface.

Van Buren's, Fig. 52, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Cup'ping In'stru-ments. (*Surgical.*) Divided into bloody and dry.

Bloody cupping. See Fig. 1552, p. 659, "*Mech. Dict.*," and SCARIFICATOR, Fig. 4662, p. 2052, *Ibid.*

Cupping glasses are shown in Roman tombs as emblems of the profession of the deceased.

Dry cupping. See DEPURATOR, "*Mech. Dict.*;" AEROTHERAPY APPARATUS, p. 8, *supra.* For Junot's arm and boot, see ARM; BOOT.

Cup'ping Ma-chine'. (*Cartridge.*) The first machine in bullet-making. It has two stamps or dies, one working inside the other; the outer one cuts the blank out of a sheet of copper, and the next draws it into a cup-shape, making it ready for subsequent drawing in other machines.

Fig. 745.

Cup'ping Tool. A blacksmith's swage of cup shape, used in pairs. The one with a square shank stands in the hardy hole of the anvil. The other has a handle, and is struck by a hammer, the piece of iron under treatment being between the two cups.

Blacksmiths' Cupping Tool.

Cu'pro Man'ga-nese. See MANGANESE BRONZE.

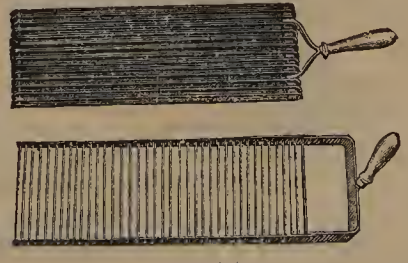
Curb. (*Mining.*) See CRIB.

Curb Sen'der. (*Telegraphy.*) An instrument, the joint invention of Sir Wm. Thomson and Prof. F. Jenkin, designed to gain speed in the working of telegraphic cables by overcoming the *tailing out* of the signal.

The object is, that as soon as the receiving end has received sufficient current to move the indicator, the charge remaining in the cable should be immediately removed; that is to say, instead of putting the line to earth immediately after making contact with the battery, as is done by the ordinary sending key, the *curb-sender* automatically puts the line to the other pole of the battery, *i. e.*, the removal of the residual charge is effected by the application at the sending end of an electro-motive force opposite in kind to that by which the signal had been produced.

"*Telegraphic Journal*" . . . . . * v. 27.
Sir W. Thomson, "*Engineering*" . . . . * xxiii. 103.
Thomson & Jenkin. Well illustrated paper in "*Jour. Soc. Tel. Eng.* . . . . . * v. 213, 248.

Fig. 746.

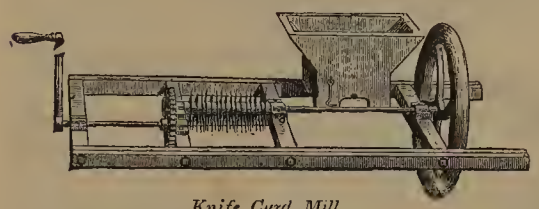


Curd Knives.

Curd Knife. A cutting implement passed through the cheese curd in the vat in order to divide it into small cubical blocks, to facilitate drainage from it of the whey.

The knives shown are perpendicular and horizontal respectively, and by suitably using each in turu the curd is equally and rapidly divided.

Fig. 747.



Knife Curd Mill.

Curd Mill. A cutting machine for dividing eheese curd into small fragments. In use the hopper (shown removed) is placed over the knives, which are rotated at a rapid rate by means of multiplying gear.

Cu-rette'. A seoop, loop, or finger, for removing foreign matter from a eavity. For instances: —

Hebra's bone scoop	Fig. 78 *b*, p. 22, Part I.
Buck's ear curette	Fig. 194 *a*, p. 44, Part II.
Speir's ear curette	Fig. 201, p. 45, Part II.
Daviel's eye curette . . .	Fig 92, p. 27, Part II.
Emmett's curette forceps .	Fig 105, p. 13, Part V.
Tieman's rectal curette . .	Fig. 57, p. 120, Part III.
Siemen's uterine curette . .	Figs. 295, 299, p. 74, Part III.
Sim's uterine curette . . .	Fig. 294, p 74, Part III.

Tiemann's "*Armamentarium Chirurgicum*."

Quires' nasal and ear curette, "*Medical & Surgical Reporter*," July 3, 1880.

See also Enucleator.

Cu-rette' For'ceps. (*Surgical.*) A long, narrow forceps, with hollow prongs to grasp and contain foreigu substances in the process of extraction. See reference in Curette.

Curl'ing Stick. A slightly tapering hot-water tube, around which to eurl the hair. — *Oppenheimer.*

Cur'rent. (*Electricity.*) The supposed flow or passage of electricity or elcctric force. It originates at the zinc surfaee in contact with the solution, and passes from the zine to the copper or other negative metal *in the liquid* of the battery, and from the *negative* metal through the eonneetions *externally* to the zinc. The quantity of eurrent flowing through a given eonductor is measured by the heat generated, by its influence on a neighboring permanent magnet, or by the amount of gas set free by its eleetrolytic actiou.

Cur'rent Ap'pa-ra'tus. (*Hydraulic Engineering.*) Devices nsed to ascertain the strength, rate, etc., of a current. See Current Meter.

Cur'rent Cool'er. (*Brewing.*) One for eooling a liquid *in transitu.*

Fig. 631, p. 264, "*Mech. Dict.*" Also, for Austrian forms, "*Scientific American Sup.*," Fig. 8, * 4077. Also forms of condensers, "*Mech. Dict.*," pp. 507-609.

Cur'rent Me'ter. The subjcct of currcnt meters has been very carefully considered, and the apparatus tested in determining the velocity of the Connecticut River.

See "*Report of the Chief of Engineers, U. S. Army*," 1878, * ii. 304 and Plate VII. The plans adopted were by surface floats and the *Waltman* tactiometer.

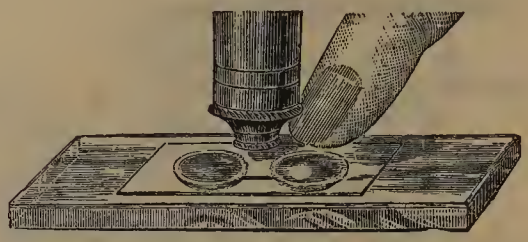
Cur'rent Reg'u-la-tor. An apparatus for regulating the motion of dynamo electric machines.

That of Hospitalier is composed of a resistance bobbin, formed of insulated wire wound on in a single layer, and having each turn stripped of its insulating covering for about 0.4 of an inch at the same spot. A curved lever, controlled by an electro-magnet at one end, and by an adjustable spring on the other, moves forward or backward on the bare portion of the bobbin if the currcut weakens or strengthens, until the resistauce is adjusted by the decreased or increased number of turns in the circuit, and equilibrium is produced.

Hospitalier	"*Telegraphic Jour.*," vii. 153; * 216.
Maxim	"*Scientific American*," xliii. 255.

Cur'rent Slide. A deviee used in mieroscopy for the examination of blood. The slide is a slip

Fig. 748.



Holman's Current Slide.

of glass with two basius ground in it, and covered by a thin glass plate. A small eanal unites the two cups, and the blood, which only partially fills the cups, is driven from one to the other by pressure of the finger on the eover, being examined in a thin film in transitu.

"*Manufacturer & Builder*"	* xii. 205.

Cur'rent Wheel. One driven by the foree of an open water eurrent.

Cleaveland	* "*Am. Miller*," vii. 41; * 307.
Submerged, *Hill*	* "*Sc. Amer.*," xxxiv. 131.

Cur'tain. (*Hydraulic Engineering.*) A woven eurtain of willows, used to reduce a current and promote deposit of silt. See Willow Curtain.

Cur'va-ture Ap'pa-ra'tus. (*Surgical.*) Apparatus for eorrection of spinal or other curvature.

The Figures refer to *Tiemann's* "*Armam. Chirurgicum.*"

Shoulder brace	Fig. 3, Part IV.
Spinal caries apparatus	Fig. 14, Part IV.
Potts' curvature brace (posterior) . . .	Fig. 4, Part IV.
Lateral curvature brace (scoliosis) . . .	Figs. 7, 9.
Tibia brace for anterior curvature . . .	Fig. 75, Part IV.
Knock-knee brace	Fig. 74, Part IV.
Weak leg supporter	Fig. 69, Part IV.
Bow-leg brace	Fig. 73, Part IV.
Torticollis brace	Fig. 11, Part IV.
Wry neck brace	Fig. 13, Part IV.

See also Club-foot Apparatus.

See also under various heads, in "*Mech. Dict.*," and list under Surgical Instruments.

Curve. A bend in a pipe, less than a quarter. See Bend.

Curve In'stru-ment. Instruments for making eurves by means of a pen connected with two pendulums swinging in planes at differeut angles to each other, or a pen to one pendulum and the paper platform to another; with discussions of the methods of Donkin, Tisley, Spiller, Knoblaueh, Peaucillier, Lissajou, Woodward: "*Scientific American Supplement*," * 505, 726, 727.

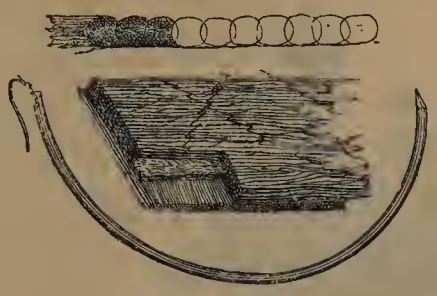
Delineator, *Scheffler* . . .	* "*Railroad Gaz.*," xxii. 491.
Measurer, *Dale*, Br.	* "*Engineer*," xlvi. 223.
Curvograph, *Curve Scribe Co.*	* "*Man. & Builder*," viii. 136.
	* "*Iron Age*," xvii. May 25, p. 9.

Curved Mat'tress Nee'dle. (*Hydraulic Engineering.*) A needle for sewing brush mats with No. 13 wire. The brush is laid in two layers, with a stratum of hay betwcen, and sewed in seams 4′ apart, and then diagonally; or the brush may be laid in two layers at right angles, and sewn diagonally at right angles. Fig. 749 shows the eurved needle on a much enlarged scale; the form of stitch, and a piece of mat with portions of oue eorner removed.

Cush'ioned Ax'le. One with a rubber eushion interposed between the axle-box and the wood of the hub, in order to absorb the jar. See Axle, Fig. 141, p. 62, *supra.*

Miller's	"*Iron Age*," * xx., Aug. 2, p. 18.

Fig. 749.



Mattress Needle.

Cush'ioned Ham'mer. A hammer with cushions interposed between the power and the hammer helve. See *Bradley's*, Fig. 6449, p. 2571, "*Mech. Dict.*"

Cus'pa-dore. A slop jar, or spittoon of vase-shaped pattern.

Cutch'er. (*Paper.*) The cylinder around which passes the endless felt in a paper machine.

Cu'ti-punc'tor. An instrument for puncturing the skin to introduce medicament. See ACUPUNCTURATOR, Fig. 27, p. 12, "*Mech. Dict.*"

Dr. Sherwell's . . . . "*Medical Record*," * Jan. 3, 1880.
Elliott's . . . . . "*Scientific American*," * xxxv. 22.

Cut'lers' Ce-ment'. For fastening blades of dinner knives in ivory handles; rosin, 4 parts; beeswax, 1 part; brick-dust, 1 part. Fill the hole in the handle with the cement, heat the tang of the blade, and press it into the handle.

Cutlery manufacture, *Sheffield* . "*Sc. Amer.*," xxxvi. 297.
Pocket . . . . . "*Man. & Builder*," xii. 155.

Cut'-off. 1. An apparatus used in steam engines to admit steam to the cylinder during a portion only of the stroke of the piston, allowing it to work expansively after the entrance of live steam from the boiler has been *cut off*.

Pages 665, 667, "*Mech. Dict.*," give illustrations, Figs. 1566–1571, of the cut-off arrangements of

Corliss.
Winter.
Stevens.
Allen.
Slide Valve.
Slide Valve, Meyrick.
Sickels.

At the Paris Exposition, 1878, a great variety of cut-off valves was shown, the slide valve, however, being used by more than half the builders represented there. Double-beat valves, Corliss valves, and a few of piston form, were used by the remainder.

In all cases of slide-valve engines, except of very small ones, some arrangement for cut-off, by the use of an additional slide, was adopted; while in but few cases did the plan obtain of dividing the valve in two parts, that is, placing a valve at each end of the cylinder, so as to reduce the port contents, or distance from the under face of the valve to the cylinder, the advantage of which arrangement is apparent and would be considerable.

There were several instances in which an additional valve on the back of the main slide had some form of trigger release for working expansion, which, controlled by a governor, can close suddenly, while some few others used four separate slides — two for admission and two for exhaust — placed at the ends of the cylinder. Some of the compound engines had a single slide for both cylinders. There were some examples of receiving-valves, double-beat, above the cylinder, with slide valves for their exhaust placed below the cylinder.

The usual practice in horizontal engines is to place at least the exhaust valves underneath the cylinder, in order to allow a ready escape for water, the receiving valves being on top of the cylinder; but there were examples where all four of the valves were below the cylinder or were arranged on its side. In engines having Corliss valves the usual arrangement was maintained of placing the valves above and below the cyliuder.

The Wheelock engine valves are all beneath the cylinder.

Valve movements were in large variety in Paris, the most important being those having an automatic variable cut-off controlled by the governor. This point receives more attention in Europe than any other single feature in steam engines.

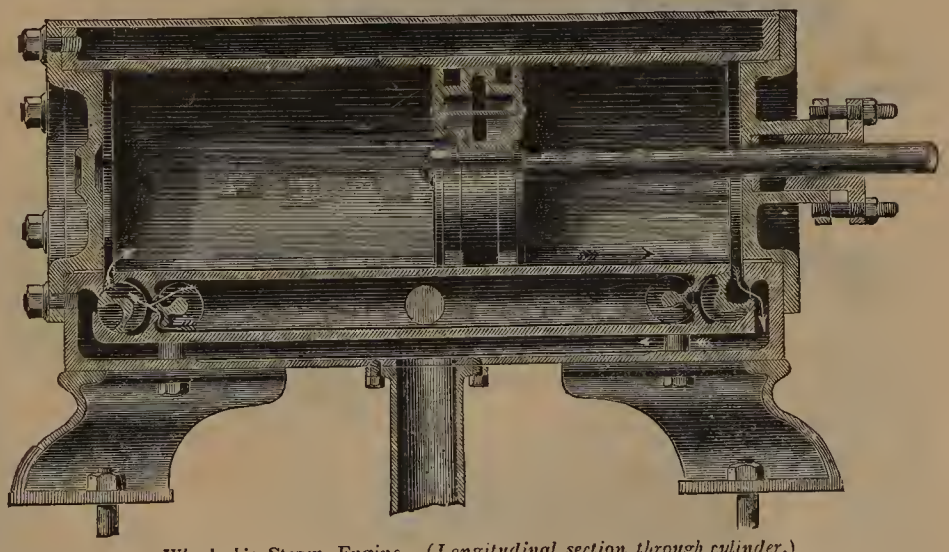
Many novel methods are in use, but all those using piston or double-beat valves employ some arrangement for trippergearing, by the introduction of a detent, or the alteration of the position of a wedge or incline. In some cases the motion is taken from the pitman, but generally from an eccentric on the main shaft or on a lay-shaft alongside, the governor controlling the position of the device for determining the point of cut-off.

Several automatic cut-off arrangements are in use in Europe with slide-valve engines, but the larger portion of them have some form of extra slide-valve, whose position is determined by right and left screws, the screw-shaft being rotated by the governor. Either this arrangement, or something its mechanical equivalent covers all, excepting those where the Rider gear is used and some other cases where the governor rotates an eccentric which varies the point of closure.

The Wheelock steam-engine furnished the power to operate the machinery in the United States, Swedish, and Norwegian sections at the Paris Exposition, and received a Grand Prize.

The peculiarities of this engine are a reduction to the simplest expression of the instantaneous cut-off valve, which forms the chief feature in the modern first-class engine. Side and sectional views of the cylinder are shown. Instead of four ports this engine has but two, one at each end of the cylinder, directly underneath it. There is at each end of the cylinder, close behind the port, one main and one cut-off valve, views of which are shown in Figs. 750 and 751. Each main valve has a cavity for exhaust, is slightly conical in shape, and is carried in hardened-steel bushes on hardened-steel trunnions.

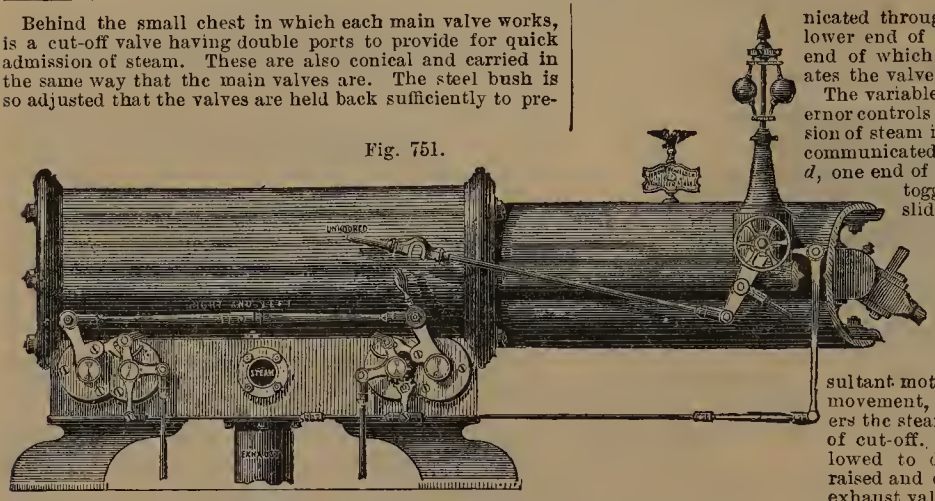
Fig. 750.



Wheelock's Steam Engine. (*Longitudinal section through cylinder.*)

Behind the small chest in which each main valve works, is a cut-off valve having double ports to provide for quick admission of steam. These are also conical and carried in the same way that the main valves are. The steel bush is so adjusted that the valves are held back sufficiently to prevent contact between the sliding surfaces, thus transferring the slight wear to the gudgeons and bushes, which would be inconsiderable in very long service. The cut-off valves are released by the action of the governor, and are closed by weights falling in dash-pots.

Fig. 751.



Wheelock's Steam Engine. (*Side view of cylinder, showing valve glass.*)

The arrangement not only reduces the clearance to a minimum, but guards against a trouble found in four-port cylinders, in a waste of steam through the exhaust-port if there be a leakage in the cut-off valve.

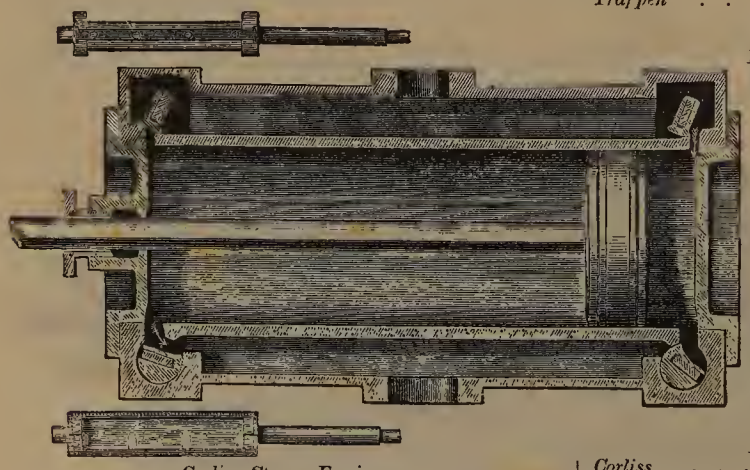
The mechanism for moving the valves is exceedingly simple and effective, easily gotten at, and not liable to excessive wear.

The packing-rings are self-adjusting segmental lap-joint rings, making an effective and tight piston. This was demonstrated on several occasions by removing a cylinder-head and operating the engine with the cylinder open.

The dimensions of the engine exhibited were —

Diameter of cylinder, 17″.

Fig. 752.



Corliss Steam Engine.

Length of stroke, 48″.
Diameter of fly-wheel, 14′.
Width of face, 25″.
Average steam pressure, 60 lbs.
Revolutions per minute, 62.
Estimated horse-power, 125.

The arrangement of the Corliss valves is shown in Fig. 752. There were in Paris many representatives of this form of engine from most European countries; although, as at Vienna, in 1873, Mr. Corliss personally did not exhibit, yet his engine was largely and admirably shown by other parties. See, also, Fig. 5666, p. 2341, "*Mech. Dict.*"

The steam-engine exhibited by A. Collmann, of Vienna, Austria, has an ingenious arrangement of valve-gear differing from the usual system of catches and pawls.

The engine is shown in a perspective view in Plate VIII., and in transverse section in Fig. 753.

The valves for the admission of steam are caused to operate by means of the combination of two motions, one of which, taken from the main shaft through miter-wheels, is constant, while the other, taken from a governor, is variable. Referring to the Plate, a constant motion is communicated through a lever, *a*, to the lower end of a toggle, *b*, the other end of which attaches to and operates the valve-stem, *c*.

The variable motion from the governor controls the duration of admission of steam into the cylinder, being communicated to the toggle by a rod *d*, one end of which attaches to the toggle and the other to a slide, *e*, carried on an arm, *f*, worked by the positive motion, the position of which slide on the arm is regulated by the action of the governor, through the rod *g*, the arm *h*, and the rod *i*, and the resultant motion gives a determined movement, which raises and lowers the steam-valve for all degrees of cut-off. The valve is never allowed to drop, but is quickly raised and quickly lowered. The exhaust valve may be operated in any convenient manner.

The following references may be consulted: —

"*Engineering.*"

Ashworth . . . . * xxi. 314.
Gen. Engine & Boiler Co. * xxi. 357-359.
Corliss . . . . . * xxviii. 154, 189, 487; * xxix. 324.
Corliss . . . . . xxi. 187, 413, 356; xxii. 12.
Tremper . . . . . * xxii. 2.
Wanneick & Köppner . * xxiii. 173.
Coltman . . . . . * xxiv. 473; xxv. 46; * xxviii. 109.
Duvergier . . . . . * xxv. 428.
Dick & Stevenson . . * xxv. 184.
Winterthur. Brown . * xxv. 475.
Marshall . . . . . * xxvi. 31, 450, 453; * xxviii. 4, 24.
Sulzer Bros. . . . . * xxvi. 133.
Halpin . . . . . * xxvii. 480.
Vivck . . . . . * xxviii. 187-90.
Hartnell . . . . . * xxviii. 3.
Proell . . . . . * xxix. 416.
Trappen . . . . . * xxvii. 520.

"*Engineering and Mining Journal.*"

Buckeye Eng. Co. . * xxiii. 334; xxvi. 224.
Weston . . . . . * xxvi. 220.

"*Mining and Scientific Press.*"

Dingley . . . . . * xxxvii. 361.
Wheelock . . . . . xl. 257-265.
xl. 56, 364, 369.

"*Paris Exposition Reports.*"

Wheelock . . . . . * iv. 369.
Powell . . . . . * iv. 371.
Collmann . . . . . * iv 372.
Winterthur . . . . . * iv. 375.
Beer . . . . . * iv. 376.
Sulzer Bros. . . . . . * iv. 377.
Herman-Lachapelle . * iv 379.
Brotherhood . . . . . * iv. 380.

"*Iron Age.*"

C. B. Brown & Co. xviii., Sept. 7, p. 7.
Buckeye Eng. Co. . xviii., Sept. 7, p. 7
Corliss . . . . . xviii., July 27, p. 1.
Putnam Mach Co. . . . . . xviii., July 27, p. 1
Wheelock . . . . . xviii., Sept. 21, p. 3.
Woodruff & Beach . . . . . xviii., Sept. 21, p. 3.
Wetherell & Co. . . . . . xviii., Sept. 21, p. 3.
Mirrless, Tait & Watson . . . . . xviii., Sept. 21, p. 3.
Goldie & McCulloch . . . . . xviii., Sept. 21, p. 3.
Proell . . . . . * xxvi., July 8, p. 1.
Bilgram . . . . . * xx., Oct. 18, p. 1.
Collmann . . . . . * xx., Nov. 14, p. 1.
Porter-Allen . . . . . * xxii., Oct. 10, p. 1.
Tappen . . . . . * xxiv., Aug. 7, p. 1.

"*Manufacturer and Builder.*"

Buckeye Engine Co. . . . . . * xi. 73.
Cobb . . . . . * xi. 126.
Whitehill . . . . . xii. 241.

"*Mining and Scientific Press.*"

Buckeye Eng. Co. . . xl. 209, 217.

"*Engineer.*"

Corliss . . . . . * xli. 319, 413; * xlii. 276; * xlv. 405.
Crohn . . . . . * xli. 394

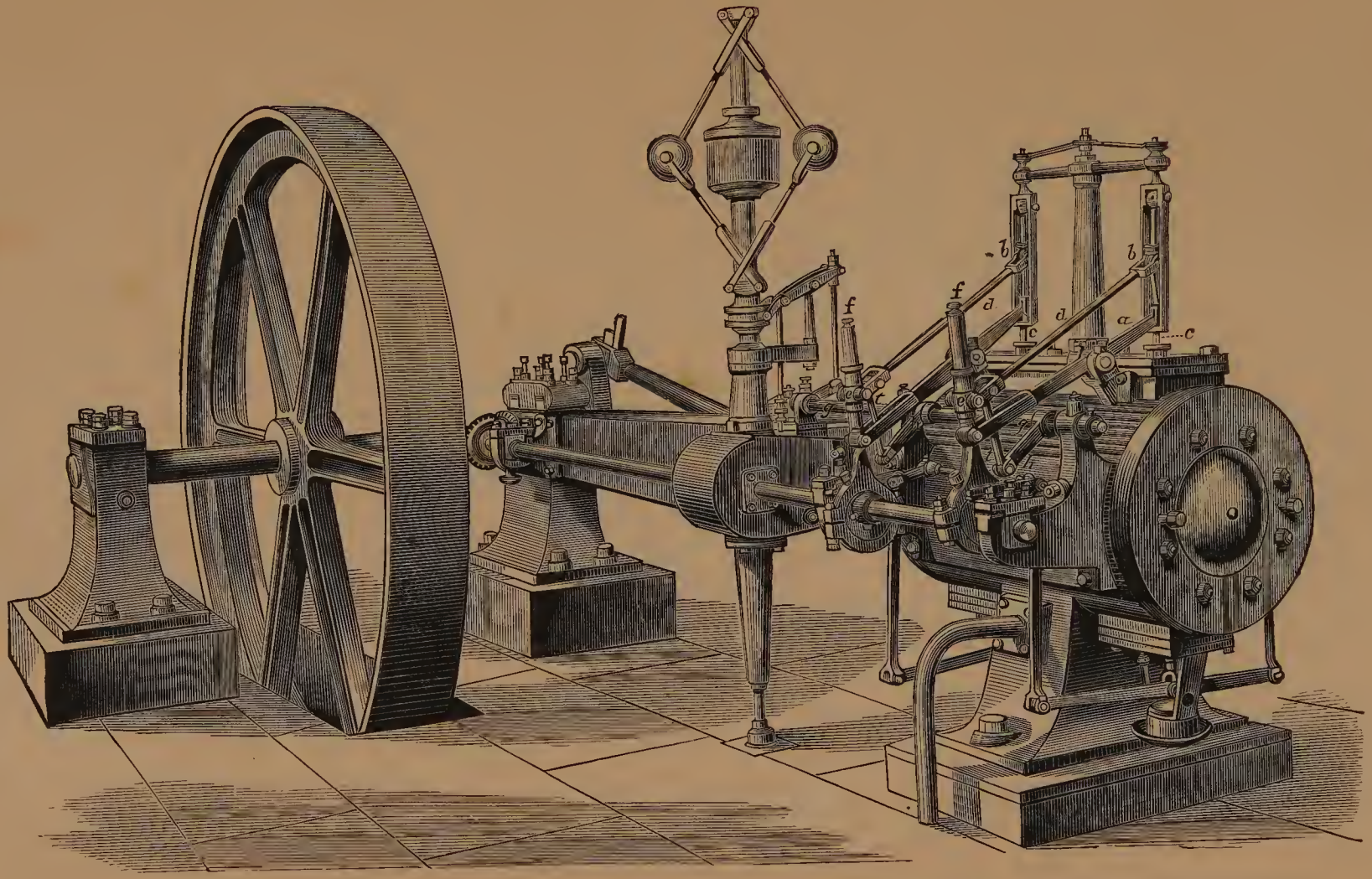
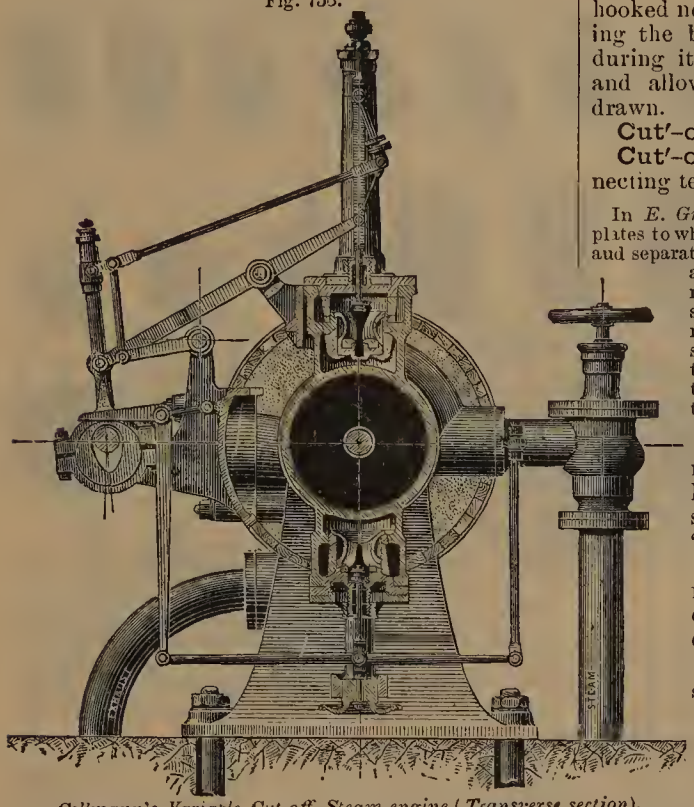


PLATE VIII.

COLLMANN'S VARIABLE CUT-OFF STEAM ENGINE. (*Perspective View.*)

See page 238.

Fig. 753.



Collmann's Variable Cut-off Steam-engine (Transverse section).

"*Mining and Scientific Press*" (*continued*).

Ruston, Proctor & Co.	* xlvii. 460.
Davey, Paxman & Co.	* xlviii. 3.
Gray	* xliv. 41.
"*Buckeye*"	* xlii. 262.
Collmann	* xlv. 144.
Rigg	* xlvi. 421.
Sulzer	xlvi. 149.
Galloway	* xlvi. 241.
Dingley	* xxxvii. 353, 361.

"*English Mechanic.*"

Slide	* xxv. 16.
Corliss	xxiv. 155.

"*Scientific American.*"

Harris-Corliss	* xli. 175; * xxxv. 95; * xli. 175.
Collins	* xli. 102.
Collmann	* xxxviii. 386.
Corliss	* xxxiv. 351; * xxxv. 340.
"*Buckeye*"	* xxxviii. 310.
Putnam Machine Co.	* xxxv. 351.
Dingley	* xxxix. 31.
Fish	* xxxvi. 166.
Brown	* xxxvi. 1.
Cobb	* xl. 310.

"*Scientific American Supplement.*"

Sulzer	* 2322.
"*Buckeye*"	370.
Penny	* 404.
Corliss	274; * 402, 403; * 1023.
Sickels	703.
Soc. Anon. de Marcinelle	* 4136.
Wannieck	* xxiv. 387.

"*American Miller.*"

Regulations for tests, Cincinnati, 1880	viii. 55.

"*Polytechnic Review.*"

"*Buckeye*"	* Aug. 12, 1876.
Bilgram	* Jan. 27, 1877.

See also EXPANSION VALVE GEAR.

2. A device in a stove magazine to separate the ashes and clinker from the fire, and to hold the fire in position while the ashes and clinker are tumbled off the grate and then removed. The grate being restored, the cut-off is withdrawn, and the fresh fire is allowed to fall upon the grate.

3. (*Sewing Machine.*) A device used with a hooked needle for the purpose of closing and opening the barb, to retain the thread in the needle during its passage through the goods or leather, and allow it to escape after the needle is withdrawn.

Cut'-off Saw. See CUTTING-OFF SAW.

Cut'-out. (*Electricity.*) A device for disconnecting telegraph instruments from the main line.

In *E. Gray's* (Patent 110,970), two springs hinged to the plates to which the terminals of the main line are connected, and separated by an insulating block, are provided each with a platinum-tipped contact-screw, and are so arranged that when turned into one position said screws bear against each other and complete the main circuit; but when in the other position, the springs bear against the termiual beveled studs of the loop or instruument circuit, thereby separating the contact screws and completing the circuit through the loop.

Cut Splice. (*Nautical.*) A loop splice made by a short piece of rope, the strands laid open at the ends and spliced into a standing rope, as in *k n*, Fig. 5435, p. 2279, "*Mech. Dict.*"

Cut Stone. (*Stone Cutting.*) Another name for ashlar, which see. The term covers all squared stones with smoothly-dressed beds and joints.

The following are modes of face-dressing (which see): —

Bush-hammered.	Pointed.
Crandaled.	Rough pointed.
Fine pointed.	Rubbed.
Peen-hammered.	Tooth-axed.

Cut'ter. 1. (*Ordnance.*) An instrument for determining the pressure per square inch exerted within the bores of cannon or small arms by the ignition of powder.

Fig. 754.

This form of instrument for the purpose derives its name from the fact that the pressure of the igniting powder is exerted upon a piston, the reverse of which has a cutter which makes a mark (cut) upon a copper block. See, also, CRUSHER GAGE; PIEZOMETER.

Plates III., X., accompanying Appendix I. *b*, to "*Report of Chief of Ordnance, U. S. A.*," 1877, are illustrations of such *cuts*, and the text accompanying pp. 373-396, describe the instrument and results, referring to Plates I.-X.

Several forms of cutters are there described.

The Rodman cutter is also used in Lieutenant Metcalfe's recoil dynamometer for small arms. "*Ordnance Report*," 1878, Appendix N., p. 109.

Milling Cutters. (Brown & Sharpe.)

2. (*Agriculture.*) An instrument attached to the plow to cut the sod or weeds in advance of the share or the breast of a plow. There are several kinds and modes of attachment. See COLTER.

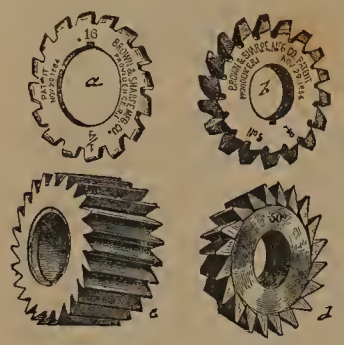
Fig. 755.

Milling Cutter.

3. (*Machinery.*) A cutting tool in a lathe, planer, or milling machine. Figs. 754, 755, 756, show several forms of rotary in milling machines and some forms of special machinery of cognate character.

Fig. 754 shows two forms of milling cutters: the upper one is for cutting the teeth of gear wheels,

Fig. 756.



Screw-slotting Cutters.

a. For making twist drills.
b. For grooving taps and reamers.
c. Grooving and milling cutter.
d. Angular cutter.

and can be sharpened by grinding without changing their form.

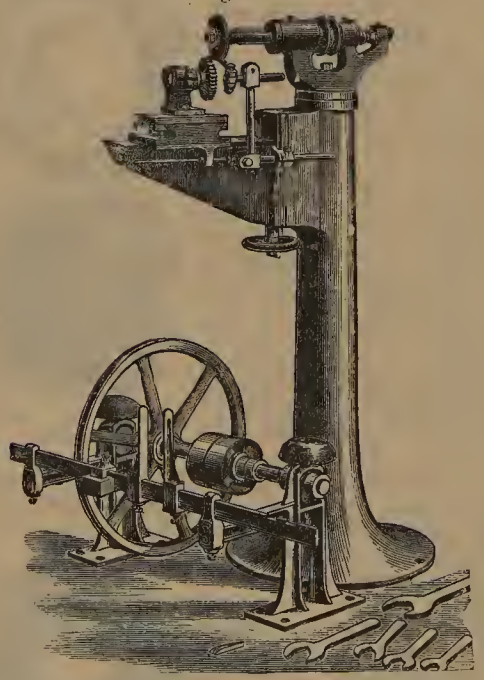
The lower cutter in the figure is for milling sewing machine and gun parts of irregular form.

Fig. 755 is a screw-slotting cutter.

Fig. 756 shows four cutters.

Cut'ter Grind'er. Is a tool for shops and manufactories in which rotary cutters of any style are used for gear-cutting, milling, or slotting. A columnar support, with a broad base, sustains the spindle-head, the cutter-holder and guide. The platen to which the holder and guide are attached may be adjusted in height to suit the diameter of the cutter to be operated upon. The guide rests against the tooth that is being ground, thus gaging the work accurately, even though there may be irregularity in the size of the teeth. The machine is adapted to cutters of all sizes and styles of teeth, whether straight, beveled, or spiral.

Fig. 757.



Cutter Grinder. (*Smith & Coventry, British.*)

Either small grindstones or emery wheels may be attached to the spindles.

Cut'ter Head. (*Wood Working.*) A rotary cutter stock in a planing, grooving, matching, or similarly-acting machine.

The illustration shows a variety of heads, including sash, door, straight-cap, slotted combination molding, panel, matching, grooving, gaining, beading, coping, etc.

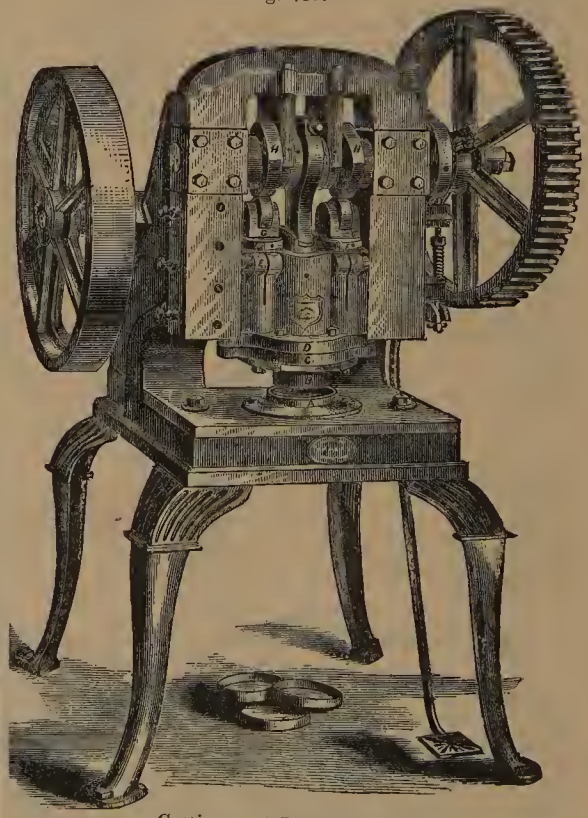
Fig. 758.

Cutter Heads.

Cut'ting and Draw'ing Press. A machine made in various sizes for different grades of work in cutting a blank out of sheet-metal and forming it into shape at one operation. The machine shown is adapted for articles not exceeding 8″ in diameter and $1\frac{1}{4}$″ deep.

The die *A* is secured to the bed of the press and the cutting punch *B*, which also acts as blank-holder, to the adjustable plate *C*. The pressure of the punch upon the blank is regulated by the screws *F F*, which are bored out to receive the casing *G G*, on the lower end of which are rubber washers to allow for difference in the thickness of the tin. The

Fig. 759.



Cutting and Drawing Press.

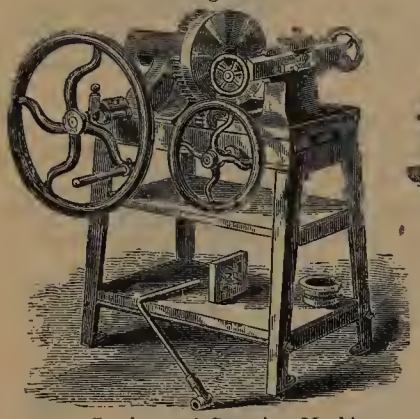
cams *H H* force down the cutting punch and blank holder and a central drawing punch forces the blank into the shape required. The slide is kept against the cams by a weight.

The *Bliss* cutting, drawing, and stamping press performs at one operation, the cutting of the blank, drawing it into

shape and embossiug any required design upon it. It is particularly designed for work that is lettered, beaded, countersunk or embossed, such as sardine and blacking boxes, covers and bottoms of cans and lard pails, etc.

Cut'ting and Screw'ing Ma-chine'. A machine especially adapted for cutting off wrought-iron pipe and tapping the ends for coupling lengths. The pipe is held in the hollow head which has a universal chuck, and the dies are held on an adjustable pillar. The chuck-head is revolved by crank and fly-wheel or by power.

Fig. 760.

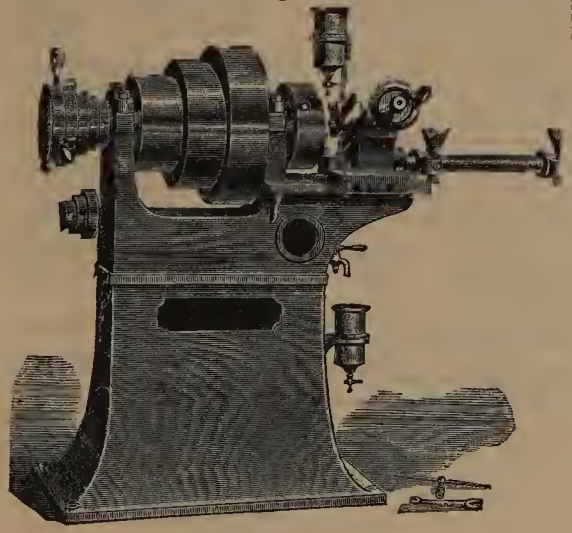


Cutting and Screwing Machine.

Cut'ting Ma-chine'. A machine for cutting crackers from the blanket of dough. See CRACKER MACHINE.

Cut'ting-off Lathe. A machine with which rods, bars, and pipes are cut to length. The object is passed through a collet at the rear end of the spindle, and held in front by a concentric chuck. The steadying collets are changed to fit various sizes of bars. The feed is automatic or by

Fig. 761.



Cutting-off Lathe

hand and the speeds variable. The *Slate* cutting-off tool is used, the stock of which receives the cutter in a channel on its side, and the cutter is held in place by flanges on the stock and two hook-headed bolts, allowing the cutter to be advanced as it is ground for sharpening.

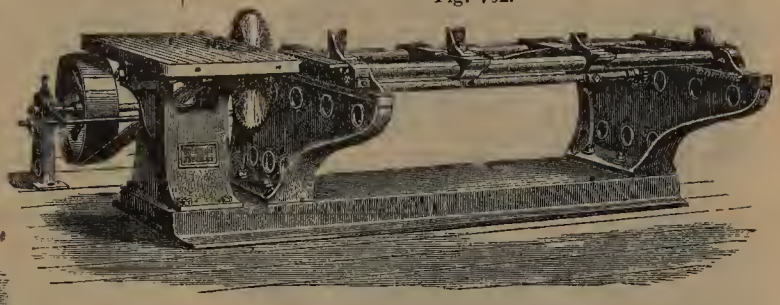
* "*Engineer*" . . . . . xlii. 42.

Cut'ting-off Saw. The cutting-off saw is a cross cutting machine adapted to the shop. The cross cutting machine for the woods is a *drag*-saw. Fig. 1739, p. 738, "*Mech. Dict.*"

Cutting-off saws are of several kinds: single and double; the latter may be *double-enders*, for sawing boards to a length, cutting off both ends at once.

1. In the *railway cutting-off saw* the saw arbor is on a carriage which traverses on planed guides, to and fro. Fig. 4134, p. 1867, "*Mech. Dict.*"
2. The *bracket cutting-off saw* traverses on a bracket above the table upon which the staff lies. See BRACKET CUTTING-OFF SAW, *supra*.
3. The *swing cutting-off saw* is pendulous from the ceiling, Fig. 6127, p. 2471, "*Mech. Dict.*"
4. The *carriage cutting-off saw* has a carriage in which the stuff lies and which moves on ways transversely to present the stuff to the saw.

Fig. 762.



Carriage Cutting-off Saw.

Cut'ting-off Shears. A bar shears for cutting bar or rod iron to lengths. Fig. 586, p. 241, "*Mech. Dict.*"

Cut'ting Punch. A circular-edged punch used for cutting grommet holes in sails, cutting wads from cloth or paper, disks or planchets from leather or metal, making tongue-holes in straps and in various other uses and connections. See WAD-PUNCH, Fig. 7001, p. 2717, "*Mech. Dict.*"

Oval or oblong cutting punches are used for some purposes, — for setting-in oblong grommets, for instance.

Cy'clad. A circular iron-clad. A style adopted in several vessels of the Russian navy, as the "Novgorod," "Admiral Popoff."

"*Engineer*" . . . . . * xli. 75, 93, 244.

Cy-cloid'o-graph. An instrument invented by *Dr. S. Zmurko*, for the practical drawing of cycloids.

"*Scientific American Supplement*" . . . . . 505.

Cy'clo-graph. An instrument invented by Worthington (Eng.), for drawing arcs of great radius.

It is a rolling instrument having two wheels of different diameters on a single shaft, one being capable of adjustment towards or from the other. The nearer the two are in relation to each other, the smaller will be the radius of curve described by a pencil attached to the shaft near the larger wheel.

"*Scientific American Supplement*" . . . . . * 3907.

Cy-clom'e-ter. An instrument for counting revolutions. Shown as adapted to a bicycle in —

"*Engineer*" . . . . . * xlv. 234.
"*English Mechanic*" . . . . . * xxvii. 321.
"*Mining & Scientific Press* . . . . . xxxvi. 403.

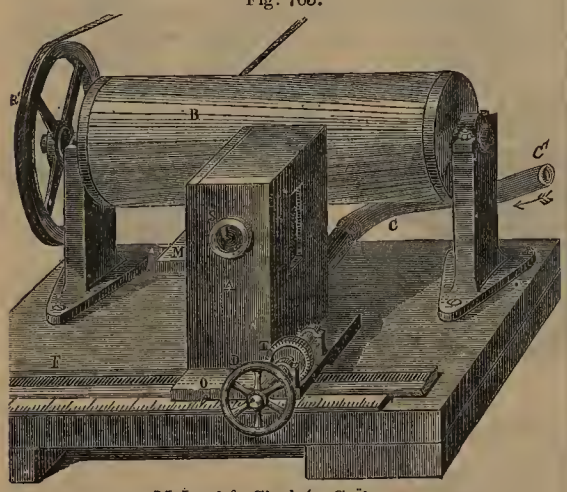
Cy'clo-scope. An instrument invented by Professors McLeod and Clarke of the Royal Indian Engineering College.

Its purpose is to measure the velocity of revolution, and enable it to be determined at the moment of observation.

B, Fig. 763, is the cylinder with its ruled paper covering. The wheel *R* serves to put it in communication with the machine, the rotary speed of which is to be measured. The movable box contains a reed or vibrating lance, which performs the functions of a tuning-fork, and to which is fastened a small plate of zinc, in which there is a slit about equal in width to the breadth of the lines traced upon the cylinder. The lance vibrates 60 times per second. The

small-toothed wheel *T*, and the wheel *D*, being situated upon the same axis with the box *A*, the latter can, by simply turning the wheel *D*, to the right or left, be moved to any position in front of the cylinder. At *S* is an opening through which the lines are examined; it contains a lens for the purpose of magnifying the images. When the apparatus is to be operated the plate is caused to vibrate by means of a small bellows, the tube of which is seen at *C C'*. The box *A* carries an index by means of which the speed is

Fig. 763.



McLeod & Clarke's Cycloscope.

read upon a graduated scale. Supposing that the cylinder is revolving and that we wish to learn its speed, we place the eye at *S*, and with the right hand turn the wheel *D*, until we meet with the stationary wave which has served to determine the divisions; the index *O* will then point to the figure that indicates the speed.

The idea of the machine is founded upon the observation that if a series of objects (points, for instance) are moving with a certain velocity, the eye loses their outlines and

Fig. 76.

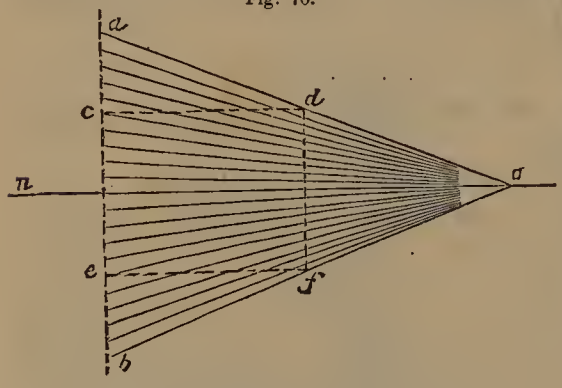


Diagram of Ruled Paper for Cycloscope.

blends them together into a line. The ruling of the paper on the cylinder is such that the lines are much farther apart at one end than the other, and this is conveniently accomplished by cutting an oblong piece sufficient to wrap the cylinder, out of a piece ruled as in the figure.

It will be evident that when the cylinder is revolving at a given rate the number of repetitions of the line, which, as viewed through the slit, is equivalent to a dot, will be much greater at one end of the cylinder than at the other.

The device is much more fully described in "*Proceedings of the Royal Society*," in "*Popular Science Review*" and "*La Nature*," and copied into the "*Scientific American*," xli. * 131; "*Scientific American Supplement*," 1188, 1366. See also "*Engineer*," xlviii * 225.

Cyl'in-der Bor'ing Ma-chine'. A cylinder borer, portable, and adapted to the reboring and refacing of locomotive cylinders while the cylinder is attached to the engine, is made by the New York Steam Engine Co. under Chapman's patent.

The machine is so arranged that it can be attached to an engine standing on the track, and is driven or worked either by hand or power to bore the cylinder and turn and face the edges of the flanges. The boring head slides upon a bar 4″ in diameter, one end of which is placed in a bushing fastened in a stuffing-box, and the other end runs in a bearing bolted to the cylinder-flange. The boring head has three tool-holders, which will receive either boring, facing, or turning cutters, and each or all of the cutters have an automatic and a hand feed. These machines will bore a cylinder as small as 15″ and as large as 20″ in diameter, with an extreme traverse of head of 32″.

Boring machine.

Sharpe, Stewart & Co., Br. "*Sc. Am. Sup.*," 2094.
Portable . . . . . * "*R.R. Gaz.*," xxii. 355.
Flanders . . . . . * "*Min. & Sc. Pr.*," xxxvi. 289.
Measuring instr., *Giegly* . * "*Engineer*," xlix. 259.
Molding, *Tuck* . . . . . * "*Sc. Amer.*," xxxv. 51.

Cyl'in-der Car. A cylinder with wheel-ends adapted to run on a railway track. The cylinder is loaded full, and rolls, the load not being supported on axles.

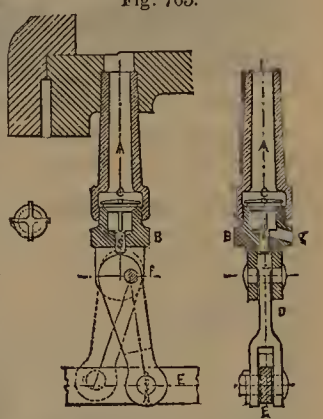
There have been many patents on this idea.
Prosser's . . "*Scientific American*," xli. 293.
"*American Manuf.*," March 26, 1880, p. 12.

Cyl'in-der Cock. Figure 765 shows a cock operated by pressure of an eccentric against a valve normally closed by the pressure of steam in the cylinder.

The view shows two sections at right angles. The tube *A* is screwed into the cylinder, and into it is screwed a plug *B*, the end of which is the seat of valve *C*. The eccentric of the lever *D* is pivoted at *f*, and is moved by the rod *E*, pressing the eccentric against the stem *s* of the valve. *g* is the exit for the steam or the water of condensation, as the case may be.

"*Railroad Gazette*,"
* xxiii. 436.

Fig. 765.



Hayes & Schlack's Locomotive Cylinder Cock.

Cyl'in-der For'ging Mill. Blakey's forging mill for making tubes consists of a rotating mandrel, operating in combination with a series of surrounding rolls, which first bend the blank, then weld it, and, by continued rolling, impart a finish to the welded article.

"*Iron Age*" . . . . . * xviii. July 27, p. 1.

Cyl'in-der Glass. (*Glass.*) This method of manufacture is much older than is generally supposed. It is so much superior to the *crown-glass* process that it has at length almost entirely superseded it.

The Venetians and Bohemians blew cylinders for the windows of the 12th and 13th centuries.

Cylinder blowing was introduced into France from Bohemia in the beginning of the 18th century.

France now manufactures it in great quantity. *La Compagnie des Verreries de la Loire* produces annually 590,000 square yards of white, and 89,000 yards of colored glass.

In the north of France 25 to 30 furnaces of 8 pots produce 4,500,000 to 5,000,000 square yards.

Annual production value: 1873, $4,400,000.
1878, $3,000,000.

Composition of French window glass: —

White sand	100
Sulphate of soda	35 to 40
Lime	25 to 35
Powdered coke	1.5 to 2.0
Binoxide manganese	0.5

Cullets in variable quantity, usually the same quantity as the sand. Arsenic is sometimes added to refine the glass; vaporizing in the pot, it passes through the glass, stirring the mass, and refining it.

Green sticks of wood are used for the same purpose, and, in Bohemia, a potato at the end of an iron bar. It is the steam in each case which escapes through the *metal*, as the melted glass is termed.

A workman usually blows during 20 hours and averages from 16 to 17 per hour, making sheets 22″ × 21″.

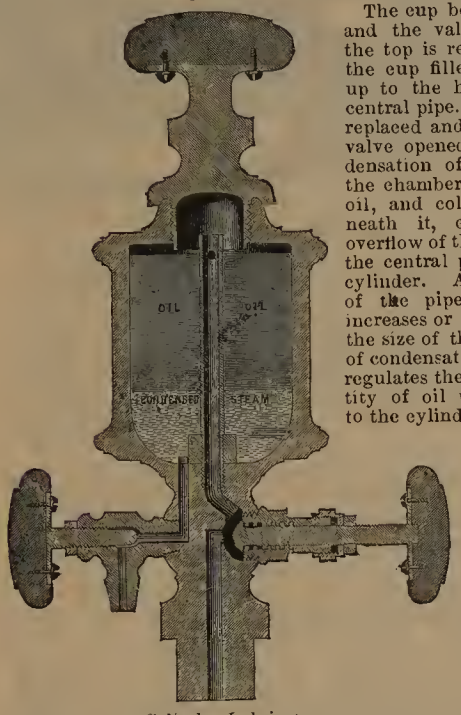
The cylinders are split with a diamond on the stick, guided

along the edge of a wooden rule laid inside the cylinder. See FLATTENING OVEN.

Cyl'in-der Grind'er. A machine tool with automatic traverse feed, for finishing cylindrical gages, such as those for gun-bores, etc. See CYLINDRICAL GAGE.

Cyl'in-der Lu'bri-ca-tor. An apparatus for supplying a regulated and constant quantity of oil to a cylinder.

Fig. 766.



Cylinder Lubricator.

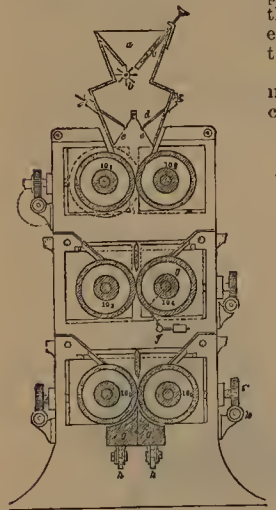
The cup being empty and the valves closed, the top is removed and the cup filled with oil up to the hole in the central pipe. The cover replaced and the steam valve opened, the condensation of steam in the chamber above the oil, and collecting beneath it, causes the overflow of the oil down the central pipe to the cylinder. Adjustment of the pipe vertically increases or diminishes the size of the chamber of condensation, and so regulates the quantity of oil passing to the cylinder.

Cyl'in-der Mill. A grinding mill in which the action of rollers is substituted for that of face stones.

(*Milling.*) The cylinder or roller mill, the *Walzenmühle* of the Hungarians, consists of two small parallel horizontal steel or porcelain cylinders placed near to each other, arranged for adjustment and revolving from above towards each other. In the great mill of Pesth the rollers are about 5″ in diameter, the surfaces of some having sharp longitudinal furrows.

Fig. 767 shows a mill with three pairs of rollers and an intervening space between the pairs. The action depends upon the distance of the rollers from each other and the character of their surfaces.

Fig. 767.



Cylinder Grinding Mill.

Smooth, and revolving with uniform speed, the action is to crush soft wheat or split hard wheat into fragments; or, if far apart, to split the berry lengthwise.

Smooth and revolving with unequal velocities, the action is to mash the grain.

Grooved cylinders, with equal velocity, indent and crack the grain; with unequal velocities tear it.

The product is not heated; no dust flour is produced. In the Pesth mill the wheat, before attaining its last disintegration, passes between from 18 to 24 pairs of rollers. Its effect is a grade between *high milling* and *low milling* (which see).

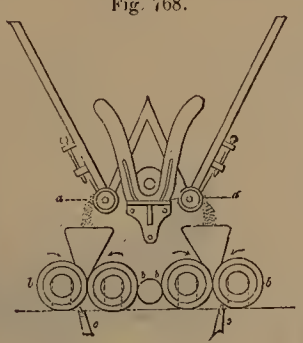
It is claimed to render grits and middling purifiers unnecessary.

That it is impossible to injure the quality of the flour in milling.

To secure a larger proportion of clean, pure flour.

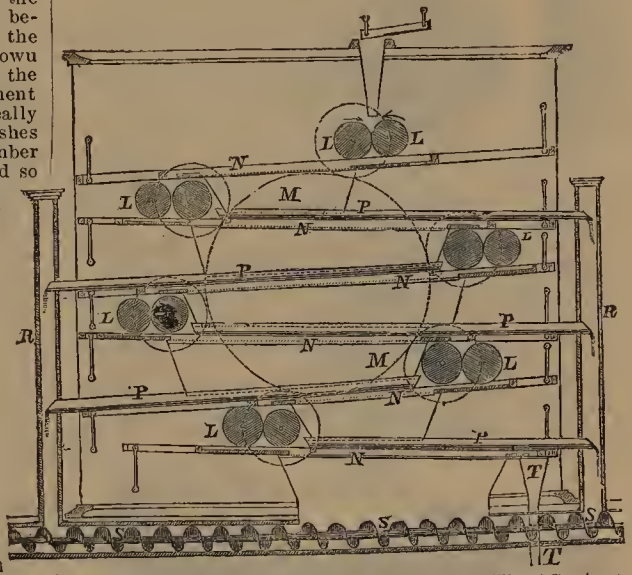
Fig. 768 is a sectional view of *Wegmann's* porcelain-cylinder mill. *aa* are the feed cylinders; *bb*, the porcelain cylinders; *cc*, scrapers with glass edges to clean the cylinders.

Fig. 768.



Wegmann's Porcelain-cylinder Mill.

Fig 769.



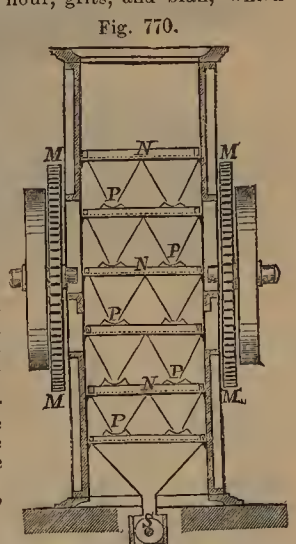
Buchholz Cylinder Grinding and Bolting Mill. (Section.)

See also GRITS MILL.

Figs. 769, 770, show the *Buchholz* roller mill.

The cylinders revolve with unequal velocity and are all set in motion by a single large cog-wheel *M*. The pointed and purified grain is fed in between the highest pair of rollers *L L*, to be cracked, as it passes through, into coarse fragments, and more or less flour, grits, and bran, which are received upon the inclined shaking-sieve *N*, where they are sorted; the grits and fine flour passing through to the trough *P*, to be discharged into the upright receiver *R*. The groats and bran pass on to the next pair of rollers, to be further reduced to finer groats, grits, flour, and bran. Falling upon the second sieve the flour and grits pass through to the trough *P*, while the bran and groats pass on to the next pair of rollers, and so on until the groats having been reduced to grits and flour, all the bran is collected in *T T*, and all the flour and grits in *S S*. The screw conducts the flour and grits to a bolt, where the flour is bolted off, and the remaining grits graded in the centrifugal machine.

Fig. 770.



Buchholz Roller Grinding Mill. (End View.)

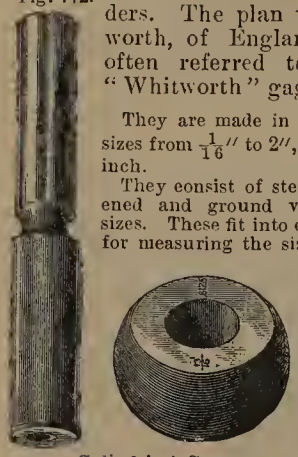
Beyer, * "*Technologiste*," xxxix. 348.

The whole system of milling has undergone great alterations within a few years past, and the new processes, which have given a name (*new process*) to the flour produced are largely used at the principal flour centers of the United States, Minneapolis, for example. Some of these improvements concern the method of grinding, *high* or *low*; others the principle of grinding, at-

trition (stones), or mashing (rollers); others the mode of handling the result, bolting and purifying.

Cy-lin'dri-cal Gage. A gage for measuring the external or internal diameter of cylinders. The plan was initiated by Whitworth, of England, and the system is often referred to under his name as "Whitworth" gages.

Fig. 772.



Cylindrical Gage.

They are made in sets, arranged in a box, of sizes from $\frac{1}{16}''$ to $2''$, varying by sixteenths of an inch.

They consist of steel cylinders and rings hardened and ground very accurately to standard sizes. These fit into each other. The first is used for measuring the size of holes, and the last for measuring the outside of cylindrical objects, and they are called *internal* and *external cylindrical gages*. They are generally used as standards alone, from which other tools and gages are made of the proper size.

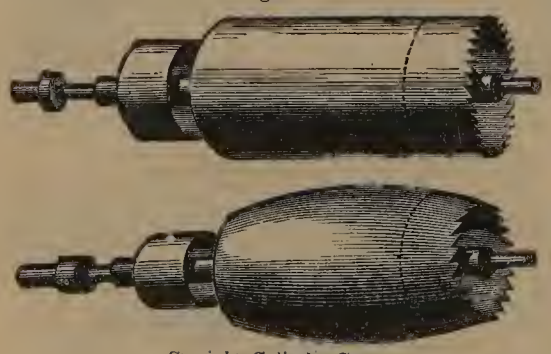
Cy-lin'dri-cal Glass. 1. A form of glass made to correct astigmatism; *i. e.*, a non-spherical form of the cornea of the eye.

2. A reading glass, for avoiding the distortions produced by an ordinary spherical reading glass.

Cy-lin'dri-cal Saw. "General Sir Samuel Bentham made cylindrical and crown saws for the British Admiralty previous to 1804. Its extensive application is, however, American." — *Richards.*

In the form shown in Fig. 772 the length of stuff that can be sawed is limited, but in another form described by *Richards* it consists of a tubular shaft or cylinder, around

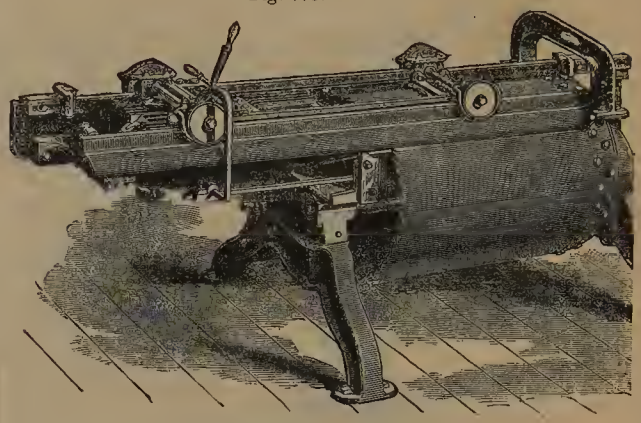
Fig. 772.



Straight Cylinder Saw.
Bilging Cylinder Saw.

which the belt passes supported in semicircular or half-bearings of the same diameter: to the end is attached a short crown saw that is as much larger than the cylinder as will clear the belt. The belt is wide, very thin, and uniform in thickness. The wood is carried over this saw by means of a carriage, the saw cutting out a semicircular core, the belt *running in the kerf* and passing through with the saw. It is

Fig. 773.



Whitney's Stave Saw.

intended for making cylindrical wooden pipes, or more especially eave troughs and conductors for the roofs of buildings.

Fig. 773 shows *Whitney's* cylindrical saw, for making pail-staves out of the balk. A steel cylinder with teeth at one end is carried at the extremity of a well-supported horizontal spindle. The length of the cylinder is somewhat greater than that of the bucket for which the staves are destined, and its diameter is such as to give them the requisite curve.

Cy-lin'dri-cal Sieve. One in which the wire surface is cylindrical; the material being usually fed in at one end and discharged at the other.

See GRAIN CLEANER, STARCH SIEVE, DRYING MACHINE, etc., for examples.

Cyr-tom'e-ter. (*Surgical.*) An instrument for diagnosis: for measuring the chest.

Fig. 774.

Dr. Weed's Cyrtometer.

Flint's cyrtometer is a compass with short arms holding strips of lead long enough to encircle the chest. An indicator may be set at any point by a thumb-screw. The strips of lead are easily molded so as to fit any elevation or depression of the chest; the thumb-screw is then loosened, and the instrument removed. The parts being restored to their former position and placed on paper, the exact shape of the chest can be traced by a pencil.

Fig. 272, p. 84, Part I., *Tiemann's "Armam. Chirurgicum."*

Dr. Weeds' cyrtometer has flexible aluminium strips to bend around the chest, and is not designed to obtain the shape, but the circumference merely.

Cys-ti'tis Eye'let. (*Surgical.*) A short flanged tube, used in inflammation of the bladder.

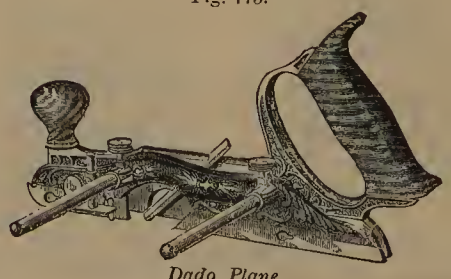
D.

Da'do. (*Add.*) (*Arch.*) A die with a projecting panel.

Da'do Plane. A tool consisting of two sections: a main stock with two bars, and a sliding section, having its bottom face level with that of the main stock.

It can be used as a dado of any required width by inserting the bit into the main stock, and bringing the sliding section snugly up to the edge of the bit. The two spurs, one on each section of the plane, will thus be brought exactly in front of the edges of the bit. The gage on the sliding section will regulate the depth to which the tool will cut.

Fig. 775.



Dado Plane.

By attaching a guard-plate to the sliding section the tool may be converted into a plow, fillister, or matching-plane.

Dai'ry Im'ple-ments. See CREAMERY; CHEESE; CHURN, etc.

Dam. 1. (*Hydraulic Engineering.*) A bank or structure across a stream.

Mattress and rubble dams in river and harbor improvements, jetties, revetments, and dams proper, are shown in the "*Reports of the Chief of Engineers, U. S. Army.*" Among others the following:—

Savannah River, 1879	* i. 742.
Corpus Christi, 1879	* i. 934.
Coffer Dam (Kanawha River), *Ibid*, 1878	* ii. 466.
Crib dam, *Ibid.*, 1879	* ii. 1440.
Crib and rubble, "*Report of Chief of Ordnance*," 1877	* 354, and Plate XII.; 1880, * ii. 1753-1762.
Movable dam, "*Report of Chief of Engineers*," 1879	* ii. 1338, 1342.

Mat and stone dam, Wisconsin River Improvements. "*Report of Chief of Engineers, U. S. Army*," 1876, Appendix X, 4, vol. ii., Part II., pp. 402, 412, and Figs. 1 to 12.

See also Reports of General Weitzel and Colonel Merrill, "*Reports of Chief of Engineers*," U. S. A., 1874-1876.

Chanoine's system	"*Scientific American*," xxxix. 313.
Chanoine barrage, Seine, Port à l'Anglais.	*Watson's* Report on Civil Engineering, "*Vienna Exposition Reports*," vol. iii., § c, pp. 37-43, Plates A, B, C, D.
Davis Island, Ohio,	"*Eng. & Min. Journal*," 1879, 456. "*Scientific American*," xli. 392.
Kanawha River,	"*Sc. American Supplement*," 1251.

See also BARRAGE; CURTAIN; DIKE; MATTRESS, etc. Also list under HYDRAULIC ENGINEERING, "*Mech. Dict.*," *et infra.*

2. (*Mining.*) *a.* A stopping of sand, clay, or brick-work built across a passage to exclude water or choke-damp, or prevent access of atmospheric air to fire-damp.

b. Choke-damp or foul air (Cornish).

3. A shield of sheet rubber clasped around the crown of a tooth to exclude saliva while the tooth is being excavated and filled.

Dam'as-ceen'ing. (*Fine Art Metal Working.*) The art of incrusting one metal on another and thoroughly incorporating. Generally, the incrusting is of gold or silver wire on the surface of iron, steel, or bronze.

The surface is engraved and undercut, the wire laid in, and the object is then hammered.

There are several common forms of damasceening: *Kuft* work and *bidiri* work, for instance. Cheap kuft work is merely gold leaf laid on to a rough etched surface, to which it adheres, while it is wiped off the smooth surfaces.

Bidiri work has for a ground an alloy of copper, lead, and tin, blackened by dipping in a bath of sal-ammoniac, saltpeter, salt, and blue vitriol.

Da-mas'cus Steel. (*Metallurgy.*) A steel made from the native iron obtained by bloomary process; broken, melted in a crucible with pieces of wood, the crucible luted and the steel melted. It is an Indian cast-steel, better known as *Wootz.* See p. 2264, "*Mech. Dict.*"

"*Mining & Sc. Press*"	xxxvii. 87.

Dam'ask-ing Met'als. (*Add.*) (*Fine Art Metal Work.*) The Japanese process called *mokume*, which may be translated "veins of the wood," is a sort of damask pattern composed of variously colored metals, chiefly white silver, red copper, and a dark blue alloy. Pieces of this very difficult sort of workmanship are produced by overlaying and soldering together a certain number of plates of the metals or alloys, by hammering, welding, re-soldering, filling up the hollow spaces with new metal, and repeating these operations many times; finally, when stretched out into a thin sheet, this composition shows a peculiar pattern, composed of veins of the different metals.

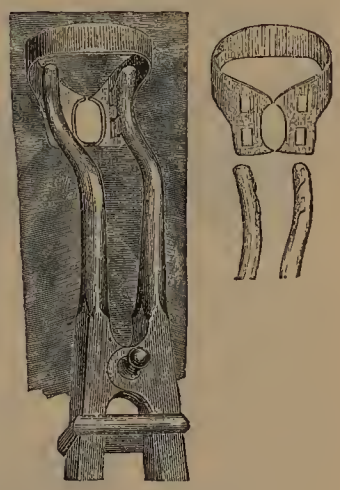
Dam Clamp. (*Dentistry.*) A device to hold a rubber dam in position around the tooth. Fig. 776 shows several forms and patterns, one of them *in situ.*

Fig. 776.

Rubber Dam Clamps.

Dam Clamp For'ceps. (*Dentistry.*) A device for putting a rubber dam clamp in position around a molar. The prongs are held at their distention by the slider on the handles, studs on the forceps jaws engaging in perforations in the flanges of the clamp. — *Dr. Elliott.*

Fig. 777.



Dam Clamp Forceps.

Damp'en-ing. 1. (*Leather.*) The moistening of hides previous to skiving or shaving.

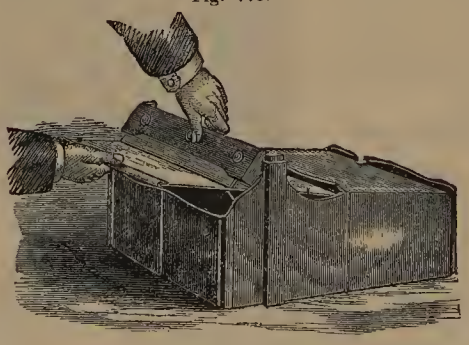
Leather under treatment is occasionally moistened with a wet sponge to make it dry evenly.

2. (*Copying.*) The wetting of bibulous paper or tablets for copying letters, etc.

3. (*Printing.*) The wetting of paper previous to printing.

Damp'en-ing Box. A case in which tablets

Fig. 778.



Hoe's Dampening Box.

are dampened for use in copying. Superfluous water is removed by drawing the tablet past the *squeegee*, which is held by the other hand.

Damp'er. A device to regulate or moderate a fire-draft.

Automatic, stove-pipe.	
Taber	* "*Scientific American*," xli. 310
Plate for fire-place, *Hanes*	* "*Scientific American*," xlii 102
Regulator	* "*Scientific American*," xlii 36.
Kelly	* "*Manufac. & Build*," xi. 172.
"Peerless"	* "*Manufac. & Build.*," xii. 30.
	* "*Manufac & Build*," ix. 232.

Damp'er Reg'u-la'tor. A self-acting arrangement in which pressure of steam acts upon a damper or register to regulate the sectional area of

a flue or draft-hole. As the steam increases in pressure in a chamber, a piston or diaphragm is moved, and acts upon the damper in the flue. There are many forms of the device, agreeing in the main features.

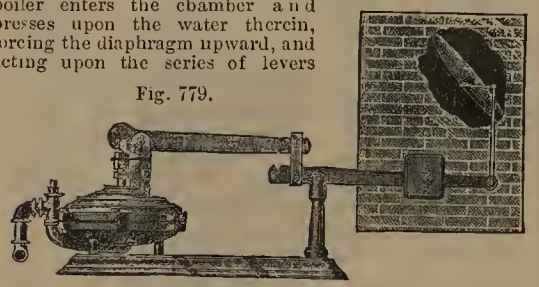
Barrett's flue damper is a butterfly valve regulated by the steam pressure in a special chamber, connecting by steam-pipe with the boiler, and adjusted by means of a balance arm and ball.

In Kelly's and Woodruff's the steam acts upon rubber diaphragms, passing between them, lifting the upper one and depressing the lower, the effective motion being the sum of the two.

In Watton's device (British), the escaping steam from a safety valve fills a subsidiary chamber, and, by depressing the piston, acts upon the lever of the damper.

In the "Peerless" damper-regulator, steam from the boiler enters the chamber and presses upon the water therein, forcing the diaphragm upward, and acting upon the series of levers which controls the damper. The steam pressure is always present, and its extent is the measure of the area of sectional opening in the flue.

Fig. 779.

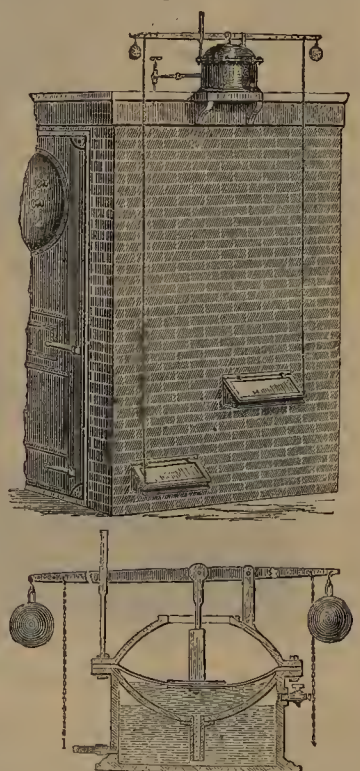


"Peerless" Damper Regulator.

The Norcross steam damper-regulator works without diaphragm or plunger, acting by displacement of water in a counterbalanced arm.

Fig. 780 gives two views of the Nason draft or damper-regulator. The upper view is a perspective of the side of the low-pressure boiler furnace, showing the apparatus *in situ*, and the connection with the draft doors. The lower figure is an enlarged sectional view of the apparatus itself.

Fig. 780.



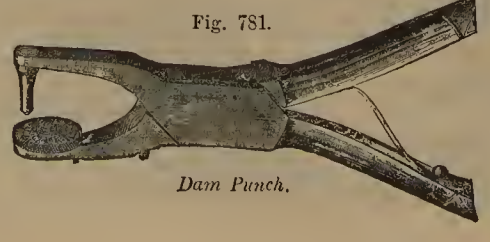
Damper Regulator.

Damp Sheet. (*Mining.*) A large sheet placed across the gate road to divert the course of the air.

Dam Punch. (*Dentistry.*) A cutting punch, for perforating coffer-dam rubber, to be used in excluding saliva from a tooth while being filled.

It has on one jaw a solid cone which cuts against either one of a series of perforations of graded sizes. The die may be rotated to bring either hole beneath the punch. Stretching enlarges the size of the hole to go over a tooth. *Dr. Ainsworth.*

Fig. 781.



Dam Punch.

Dan'cing Flame. A small drum has a very delicately sensitive elastic skin stretched over it. A stream of gas passed through this drum will burn as usual till some one begins to sing near it, when the flame, under the influence of the vibrating skin, commences to shake in a manner which is varied indefinitely, according to the pitch and intensity of the notes of the tune.

Dan'iell Bat'te-ry. (*Electricity.*) One having its zinc in sulphuric acid, and its copper in sulphate of copper, with an intervening porous cell. "The most perfect battery yet invented." *Niaudet.*

See Constant Battery.

Prescott's, "*Electricity*" . . .	* p. 48; Ganot, * 686.
Sabine, "*Electric Telegraph*" .	London, 1867, p. 221.
Niaudet, Am. translation . . .	* London, 1867, p. 86.
Noad	* London, 1859, p. 209.
"*English Mechanic*"	* xxvii. 321.
du Moncel	Paris, 1856, p. 101.
Shaffner	* N. Y., 1859, p. 91
Kiemer, impt. on Daniell . . .	Sabine, 224.
Watson, mod. of Daniell . . .	"*Sc. Am. Sup.*," * 524.
Hall, impt. on Daniell . . .	Shaffner, * 94.
Lodge, impt. on Daniell . . .	"*Teleg. Jour.*," vi. 54.
	"*Sc. Am. Sup.*," 1815
Browning, impt. on Daniell . .	"*Sc. Amer.*," * xliii. 181.
Carré, impt. on Daniell . . .	Niaudet, p. 108.
Kruger, impt. on Daniell . . .	Niaudet, p. 128.
Trouvé, impt. on Daniell . . .	"*Eng. Mechanic*," * 326.
Onimus, impt. on Daniell . . .	"*Sc. Am.*," * xxxv. 67.

Dark Tent. A portable dark chamber for photographers in the field. It is mounted on a light tripod stand. The tent, camera, trays, and plate pack in a box. The windows are of orange-colored silk oil-cloth, protected by yellow cloth.

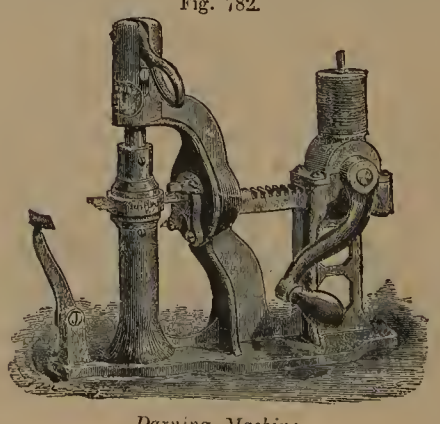
Two forms, for buggy and for hand respectively, are made.

Fig. 782.

Robbin's Dark Tent.

Darn'ing Ma-chine'. A machine for darning stockings, clothing, etc. The article or fabric to be darned is held between notched blocks, which throw it into corrugations so that the series of needles carried by a reciprocating needle-bar will pass through and through portions of the fabric.

Fig. 782.



Darning Machine.

The eye-pointed needles move in grooves in the blocks, their eyes in the same horizontal plane, and when they are passed through the fabric are all threaded by the same thread. This thread is then drawn out in loops from between each needle, and each loop is placed on a pin of a loop-holder (shown to the left) adjustable to or from the work-holding blocks to adapt the loop to the size of the hole, and on the return movement of the needle bar each needle draws a doubled loop through the fabric at each side of the hole to be darned, and leaves the thread extended across the hole. The loops of thread are then cut at the eyes of the needles and the fabric is turned on the holding blocks and clamped, so that the needles in their next movement will draw the loops then to be formed across and interweave them with the loops of thread or yarn previously laid by the needles.

Fig. 784.

Dash Lamp.

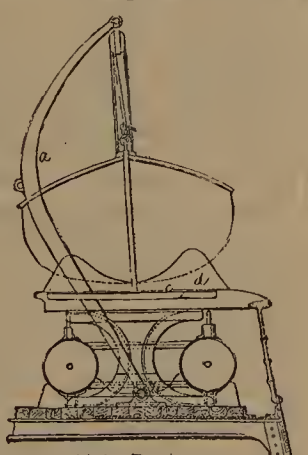
Dash Lamp. A lamp for the dash-board of a vehicle.

Daub'ing. (*Leather.*) Or dubbing. A mixture of tallow with either neat's-foot oil or sperm oil. With it dampened leather is coated, rendering the leather supple and impervious to water. *Stuffing.*

Dav'it. The boat-lowering and hoisting apparatus of the vessels of the American Steamship Company (British) is shown in Fig. 785.

The davits *a* are of round iron bent to the form shown, and hinged to brackets *b* on the deck. Each davit passes through a slot in a horizontal guide *c*, attached to suitable standards, and connected with the hand-rail of the ship. The boat is slung from eyes in the heads of the davits by suitable tackle, and is supported upon the standards by blocks *d*. These blocks are hinged to the standards, and the davits are kept in the ordinary position by a key and pin passing through the slot. When it is desired to lower a boat the pin and key are removed, the supporting blocks thrown over on their hinges, and the davits fall forward, throwing the boat clear of the ship's side. It can then be lowered by the tackle. The illustration also shows the form and position on board, of the sheet-iron rafts which these vessels all carry. The rafts are stowed under the boats, the whole being very compactly arranged, but always ready for an emergency.

Fig. 785.



Ship's Davit.
(*American Steamship Co.*)

Boat-lowering apparatus,

Allardyce, Br. . . . . * "*Engineer*," xli. 325.
And Life-raft, *Cramp* . . . * "*Engineering*," xxii. 262.
American Steamship Co Br. * "*Scientific Am. Sup*," 723.
Parker, Br.. . . . . * "*Scientific Am. Sup.*," 802.

See BOAT-LOWERING APPARATUS, p. 114, *supra;* DAVIT, p. 678, "*Mech. Dict.*"; BOAT-LOWERING DAVITS, p. 314, *Ibid.*

Dav'it Block. (*Nautical.*) One specially adapted for the tackle of ships' davits. The figure shows three kinds.

a. Swivel-hook block.
b. Swivel-eye block.
c. Screw-bolt and nut-block

Other davit-blocks have beckets to complete the combinations. See also DETACHING HOOK.

Fig. 786.

Davit Blocks.

Dead Blocks. (*Railway.*) Blocks projecting from the end of a freight car to receive the concussion when the buffer springs are compressed.

Dead Lock. 1. One having a supplementary bolt which acts as a detent to the main bolt to prevent its being moved even by the key.

2. (*Railway.*) A car-door lock operated in each direction by the key alone.

Dead Stroke Ham'mer. A hammer the stroke of which is not affected by the recoil of the crank or helve by which it is operated. Fig. 1600, p. 680, "*Mech. Dict.*"

Hull & Belden, * "*Engineering & Mining Jour.*," xxiii. 338.

Dead Weight. The weight of rolling stock, the live weight being the *load*. The following is from the report of Captain Galton, one of the British Commission at the Philadelphia Exhibition, 1876: —

The following Table shows a Comparison between the Weights and Carrying Capacity of some Railway Cars: —

Gage.	Weight of Car in lbs.	Capacity in lbs.	Total Weight.	Proportion of Dead Weight to Paying Loads.
Flat Car.				
4′ 8½″	16,000	20,000	36,000	1 to 1.25
3′.	7,500	19,000	26,500	1 to 2.5
Box Car.				
4′ 8″	17,000	20,000	37,000	1 to 1.17
3′.	10,000	17,600	27,600	1 to 1.6
Coal Car.				
4′ 8½″	17,000	30,000	47,000	1 to 1.7
3′.	9,000	20,000	29,000	1 to 2.2

Deal Frame. A saw-mill for ripping pine logs into boards, p. 2042, and Fig. 1601, p. 680, "*Mech. Dict.*"

Ransome, Br. . . . . * "*Engineering*," xxv. 424.
Worssam, Br. . . . . * "*Engineering*," xxvi. 490.

De'bris E-vac'u-a-tor. (*Surgical.*) An instrument for removing powder and fragments of calculi after crushing, in the operation of lithotrity.

The following may be found on pp. 44, 45, Part III., *Tiemann's* "*Armamentarium Chirurgicum*": —

Nelaton's evacuating apparatus.
Van Buren's debris syringe.
Glover's evacuating apparatus.
Tiemann's debris tube and obturator.
Van Buren's evacuating catheter.
Tiemann's double current catheter.
Nott's double current catheter.

See also STRINGES in same work. See also CHIP SYRINGE, *supra* and list under SURGICAL INSTRUMENTS.

De-cal'co-ma'nie. The art of ornamenting by transfer.

De-can'ter. 1. An apparatus designed by Evrard, of St. Etienne, for sorting the tailings of coal washings.

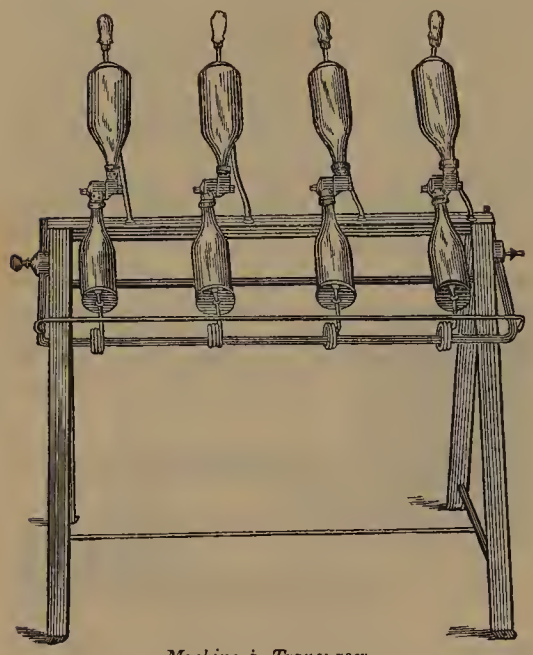
Althan's report in Group I., "*Centennial Exhibition Report*," * vol iii., p. 297.

2. A glass bottle to contain wine at table.

3. An apparatus for transfusion of wine.

The machine by Tricout & Co., of Reims, is constructed of unoxidizable material, and, being for the champagne cellar, operates without the loss of gas. A machine with 4 faucets operates on 1,500 pint bottles per day. The full bottles being beneath and the empty ones above, a turn of the handles reverses the relative position, and the wine passes into the other bottles. See Fig. 787.

Fig. 787.



Machine à Transvaser.

De-cap'i-ta'ting Hook. (*Surgical.*) A curved instrument, sharp in the concave, for beheading the fetus in cases of obstructed labor.

Fig. 527, Part III., *Tiemann's "Armam. Chirurgicum."*

Dec'i-mal Meas'ur-ing Ma-chine'. A lever scale in which the weight and the object weighed are as 1 : 10. The *bascule-décimale* is much used in France. Made by Paupier, of Paris; Duru, of Bordeaux.

Kerr, Br. . . . . * "*Engineer*," xliii. 162.

Deck Block. (*Nautical.*) One attached to the deck, as in the illustration, in which a small block is pivoted to a base-piece, which is bolted to the deck.

Fig. 788.

Deck Block.

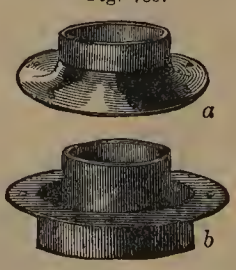
Other deck blocks are connected by beckets to deck-hooks, or by hooks to deck-eyes.

Deck Hoist'ing En'gine. (*Nautical.*) A hoisting apparatus on deck, used for getting in and out cargo and stores, getting guns, etc., aboard. It is also used on the deck of a lighter for pile-driving, or snag-lifting. As shown, Fig. 790, it is intended for working from two different points. The drums are worked independently of each other by friction, and the operations of hoisting, lowering, and stopping are controlled by the use of levers on the side of the engine, no foot-brake being needed.

Deck Pipe. One leading through a deck, affording a passage for a smoke-pipe, wind-sail, etc.

Deck Pump. One arranged to screw into a metallic deck-plate when required for use, and to unship the whole working gear when not required; a cap covering the opening in the plate, and leaving the deck perfectly clear.

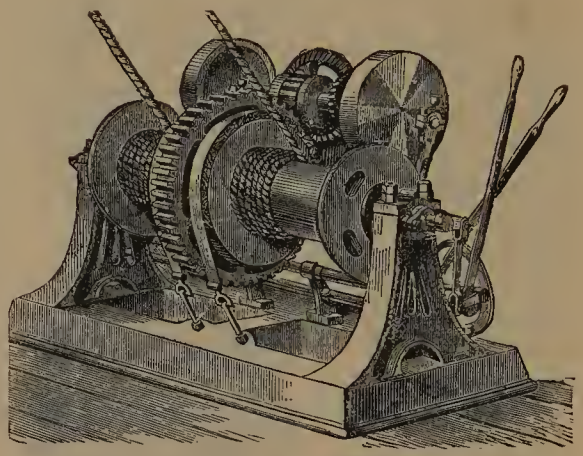
Fig. 789.



Deck Pipes.

a. Plain deck-pipe.
b. Water deck pipe.

Fig. 790.



Bacon's Deck-hoisting Engine.

De-com-pos'ing Fur'nace. A chemical furnace. Used in the soda industry in decomposing chloride of sodium with sulphuric acid.

Jones & Walsh's decomposing furnace, Middlesborough, England. Paper read before Newcastle Chemical Society, March 23, 1876. Reported in "*Scientific American Sup.*," 305. See also Professor Jenkins's Report, "*Paris Exposition Reports*," 1878, iv., pp. 44 *et seq.*

De-cor'ti-ca'tor. An instrument or machine for removing the skin, such as the bran of wheat or other grain; the surplus bark or moss from neglected fruit-trees, etc.

Glove and bow, *Sabate*, * "*Scientific American*," xxxvi. 182.

De-coy'. When artificial, a wooden, tin, or real-plumaged bird to induce wild birds to settle within range of the ambushed gunner.

Ducks, brants, pigeon, plover, curlew, snipe, are among the commoner kinds.

Decoy duck, *Redmond* * "*Scientific American*," xli. 247.

Deep Sea Ther-mom'e-ter. One for ascertaining the temperature of the sea at any required depth. It has in some respects the features of a sounding instrument, as the knowledge of the depth is one part of the problem. See SOUNDING APPARATUS, pp. 2247–2249, "*Mech. Dict.*"

The thermometer is contained in a heavy brass frame, finished at the bottom by a propeller-like spiral fan. The fan revolves as it passes through the water, and a registering device put in motion. The required depth being reached, the motion is stopped, by which action the thermometer is turned over and the temperature registered.

Subject discussed in a paper by Dr. Mann, read before the Society of Arts, and reproduced in "*Scientific American Supplement*," 934, 935.

Negretti & Zambra . . * "*Scientific American*," xxxix. 83.

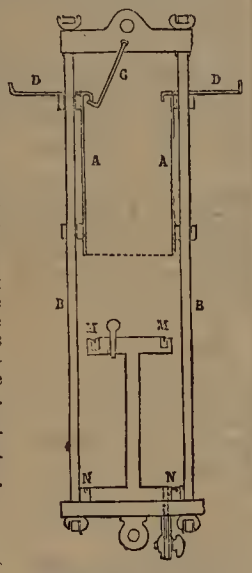
Deep Wa'ter Bot'tle. A bottle for fetching up sea-water from determinate depths to ascertain its saltness, aërial contents, and temperature.

Four Swedish instruments for this purpose were shown at the Philadelphia Exhibition in 1876. They are all grounded on the same principle. The water-specimen is drawn up in a cylindrical vessel, the walls of which form a separate piece, which, while the instrument is sinking in the water, is raised above the bottom and top of the vessel, but falls and unites with these at the depth from which the sample is required. Thus during the descent the water passes freely through the cylinder, but at the depth required the different parts of the vessel come together and inclose therein the water, which is thus obtained altogether unmixed with the water of the upper strata.

The instrument of Ekman of Stockholm, is shown in Fig. 791. *a* is the open cylinder, sliding on two bars *b b*; before the instrument is immersed in the water, the cylinder is raised and suspended by the hook *c*. Attached to the cylinder is a horizontal flange, *d d*, the size of which is so calculated, that its resistance against the water, when the instru-

ment is descending at the rate of about 6 decimeters per second, is equal to the combined weight of the flange and cylinder. As the instrument really sinks faster than that, the cylinder, as soon as the descent begins, is immediately raised somewhat more, and the hook *c* falls aside. The cylinder nevertheless still continues raised in consequence of the water's resistance to the flange, as long as the instrument continues to sink; but as soon as the line to which it is fastened is hauled in, the cylinder falls. Its under and upper (down-turned) edges then enter into the ring-shaped grooves *m m* and *n n* in the bottom and top, which are filled with a compound of wax and tallow, in which marks have been previously made with the cylinder. The cylinder contains the last body of water which occupied it; that at the level where its downward course was arrested.

Fig. 791.



Ekman's Deep-water Bottle.

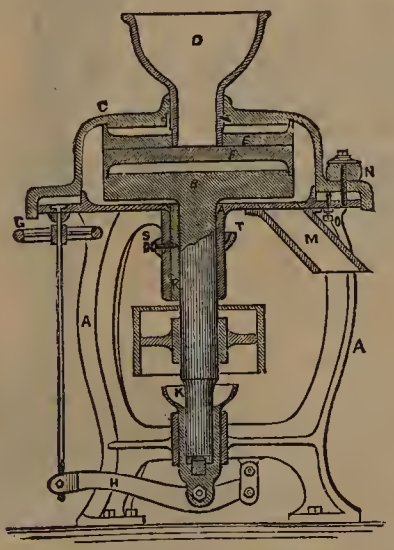
Def'e-ca'tor. An apparatus for removing the feculencies of juices and sirups. See p. 683, "*Mech. Dict.*"

Vibrans (sucre).
"*Technologiste,*" xxxvii. 323.

De-flec-tom'e-ter. Askenasy's apparatus for measuring the curve of deflection of a metallic bridge under a passing load, and used upon a bridge over the Rhine at Mayence, has a drum attached by a clamp to the bridge and moved by interior clockwork to rotate it once in 10 minutes. At the approach of a train the detent is released and the drum commences to rotate. By a special arrangement the rate of movement of the drum may be regulated to obtain curves of equal length for trains of different speeds. The drum is covered with a roll of paper gummed at the edges, so as to answer for numerous experiments, the portion covered by the curve being detached after each experiment. The tracing is made by a pencil in a statiouary position, the drum oscillating vertically in front of it. Shown in Class 54, Group VI., Paris Universal Exposition. See also Extension Measuring Apparatus.

De-form'i-ty Ap'pa-ra'tus. (*Surgical.*) Instruments for curvature of the spine or legs, for club feet (*talipes*), etc., are classed under this head.

Fig. 792.



Mills' Degerminator.

See Curvature Apparatus, Club-foot Apparatus, Torticollis, Talipes Apparatus, etc.

De-germ'i-na'tor. (*Milling.*) A mill for rupturing the wheat berry along its crease to detach the germ, which is afterwards separated from the split wheat by a short reel covered with wire cloth.

Mills' degerminator is of iron, with two furrowed disks 16″ in diameter, of the same metal, between which the wheat is rolled and cracked, freeing the germ. The disks *E F* have marginal rounded corrugations, with smooth depressed bosoms. Fig. 792.

A is the frame; the spindle-head *B*, resting in the oil-pot *K*, supports the runner *F*, which is raised and lowered by the lighter-bar *H* and handwheel *G*.

D is the hopper; *C* the husk which carries the upper stationary disk *E*, which is trammed to the lower one by the set-screw *O* and bolt *N*. *T* is the tallow-pot and *S* a set-screw regulating the gib *R*. *M* is the delivery spout.

The wheat, previously graded as to size, rolls on its side along the bosom till it reaches the corrugated skirt; ascends the easy incline (see sectional view), rotating on its axis, until it bears with its creased side on one or the other disk, when it is split open and the germ escapes from the broken grain.

Fig. 793.

Sectional View of Disks in Degerminator. Wheat Natural and Degerminated.

The figures are —a vertical section; a section illustrating the action of the disks; and wheat in its natural and degerminated conditions.

De-gla'zing. (*Glass.*) The process of giving a dull or ground surface to glass by acid or mechanical means.

De-gum'ming Ma-chine'. A machine used in treating silk before dyeing. See Silk-degumming Machine.

De la Rue Bat'te-ry. (*Electricity.*) A battery in which chloride of silver forms the negative. See Chloride of Silver Battery.

Delft Ware. (*Ceramics.*) Ware made at the city of Delft in Holland, which has been celebrated for its potteries for over three centuries. As England was largely supplied from that city, the word became a synonym for table-ware pottery.

Ware of the better kinds was made as thin as China porcelain, pure in color and of most various and fantastic shapes; sets of dishes to represent all the viands served upon them being among the number.

Pottery probably came from Delft to England.

"Crockery, china, and delft" was the refrain of an English song.

Dem'i-fixed. Or *semi-fixed.* Said of a steam-engine which is not intended to be stationary, but which has supports of such a nature that it may be moved by proper appliances, but has not wheels for transportation like the *portable* engine.

Dem'on-stra'tion Len'ses. (*Optics.*) A set of lenses showing the various forms, viz.: —

Double concave.	Plano concave.
Double convex.	Meniscus convex.
Plano convex.	Meniscus concave.

Den-sim'e-ter. An instrument for ascertaining the density or specific gravity of an object.

1. The instrument of Colonel Mallet and M. Bianchi for ascertaining the specific gravity of gunpowder, is described on p. 685, "*Mech. Dict.*"

The densimeters used in the office of the constructor of ordnance, U. S. A., for determining the specific gravities of metal for cannon, and for ascertaining the specific gravities of large grained powders, are described and illustrated in the

"*Report of the Chief of Ordnance, U. S. A.*," 1877, iii. pp. 394-400, and Plates I., II., accompanying.

In the British service the density of powder is rigorously determined, each cake being tested.

The density of rifle powder is fixed at	1.725
Pebble powder	1.77 to 1.81
R. L. G.	1.67

The *densimetre à mercure* is employed in the Russian arsenals to obtain the specific gravity of gunpowder. Shown at Plate II. accompanying Appendix 1 (c), "*Ordnance Report*," 1877.

See also the mercury densimeter of Colonel Mallet of the French army, "*Ordnance Report*," 1879, Appendix I., p. 111, and Plate VI., Fig. 14.

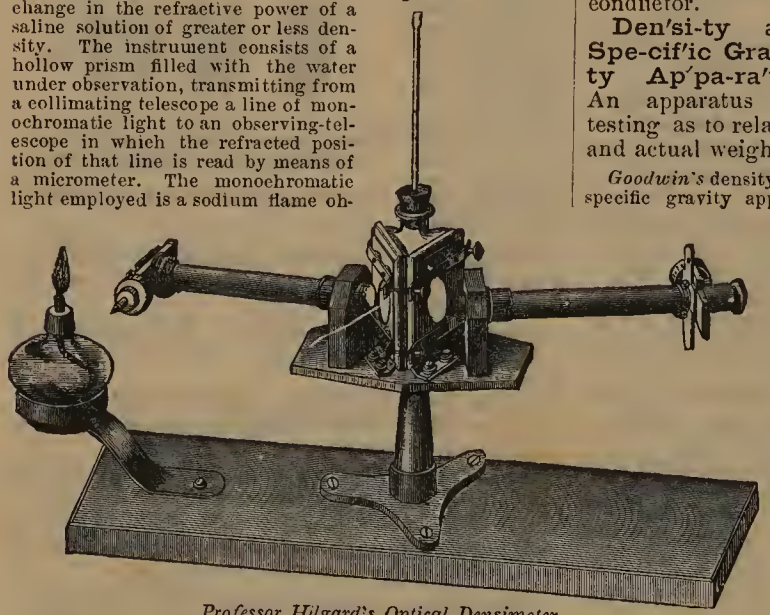
Densimeter for gunpowder, Br. . * "*Engineering*," xxv. 236.

2. The instrument invented by Professor Hilgard of the U. S. Coast Survey, for determining the density of sea-water by its refractive power, is shown in Fig. 794. It is an efficient substitute for the hydrometer or salinometer, as it is not affected by the motion of the ship. See U. S. Coast Survey Report, "Methods and Results," Appendix No. 10, Report for 1877.

The Hilgard densimeter follows the suggestion of Prof. Wolcott Gibbs for an apparatus for the "Hassler" in 1871, 1872.

Fig. 794.

The basis of this instrument is the change in the refractive power of a saline solution of greater or less density. The instrument consists of a hollow prism filled with the water under observation, transmitting from a collimating telescope a line of monochromatic light to an observing-telescope in which the refracted position of that line is read by means of a micrometer. The monochromatic light employed is a sodium flame obtained by adding a small proportion of a solution of common salt to the alcohol of the lamp. The temperature of the liquid under observation is found by means of a thermometer inserted through the neck of the hollow prism, but which is withdrawn when the optical observation is made.



Professor Hilgard's Optical Densimeter.

The glass prism rests on three little knobs so as to have a firm support. Attached to the stand carrying the telescopes are two guides, by means of which the prism is made always to occupy exactly the same position, so that all observations are made under the same angle. A small thumb-screw on the side of the prism, not seen in the plate, forces the prism closely into the guides.

The slit in the focus of the collimating lens is very readily made by drawing a fine line through a black coating (such as engravers' etching ground) on the inner surface of a glass diaphragm. In the illustration this diaphragm appears mounted on a micrometer slide, which was deemed desirable for general experimental purposes, in order to make the observations under the condition of equal refraction on both faces of the prism; but in the instruments for practical use on board ship the slit is in a fixed position. The image of the slit in the field of the observing-telescope is a sharply-defined bright-yellow line, which is pointed upon with a fine dark spider line carried by the micrometer.

The relation of the angle of refraction to the density of sea-water having been ascertained experimentally in the office, as well as the temperature-corrections for different degrees of salinity, it is only necessary to determine for each instrument the difference of micrometer reading between distilled water and sea-water of an ascertained specific gravity, and from this and the ascertained law construct two tables for its use: one giving the reduction to the standard temperature of 60° Fahr., in terms of micrometer-divisions, the other giving the specific gravity for the difference of reduced readings on distilled water and on the specimen of sea-water under observation.

3. Hueh's densimeter is adapted to indicate in either degrees Baumé or Brix, the exact density of saccharine solutions continuously during the whole operation of boiling.

"A chamber like a salinometer tube or water-gage is attached to the head of the boiler, and in this is a floating areometer. A platinum weight is suspended from the areometer, and being in the solution, which is continually renewed, the areometer index finger shows constantly the graduation corresponding to the gravity of the sirup.—"*Dingler's Journal.*" Reproduced in "*Scientific American Sup.*," * 2560.

Den'si-ty. (*Electricity.*) Used erroneously as an equivalent to *intensity* or *tension*. The same *quantity* of electricity may pass through different sized wires, but the *density* of the current passing through the smaller wire will be greater than the density of the current passing through the larger wire. Other things being equal, the density bears an inverse proportion to the sectional area of the conductor.

Den'si-ty and Spe-cif'ic Grav'i-ty Ap'pa-ra'tus. An apparatus for testing as to relative and actual weight.

Goodwin's density and specific gravity apparatus for gas testing, "*American Gaslight Journal*," * July 3, 1876, p. 6.

Fig. 795.

White's Water Motor Dental Engine.

See also DENSIMETER, *infra*; SPECIFIC GRAVITY APPARATUS, *infra*, and pp. 2255-2257, "*Mech. Dict.*"; also BALANCE, p. 212; HYDROMETER, p. 1153; AREOMETER, p. 141, *Ibid.*

Den'tal Ap'pa-ra'tus. See *Dr. J. H. Thompson's* report, "*Centennial Exhibition Reports*," vol. vii., Group XXIV., p. 11, *et seq.* "History of the art in the United States, its progress and modern practice. Base plates of Vulcanite, Celluloid, etc.; Dentures; Mechanical and Operative Dentistry."

Dental foil manufacture, *Williams*, * "*Sc. Amer.*," xxxv. 18.

See also list on p. 685, "*Mech. Dict.*"

Den'tal En'gine. A machine for running the dental burs, drills, etc., which act by rotation. In the ordinary dental engine, the S. S. White and Morrison patterns, the power is by treadle to a fly-wheel and a band from this to a grooved pulley on the summit of the column, thence by flexible shaft to the drill. The illustration, Fig. 795, shows the application of a water-motor engine, which has from 15 to 20 pounds pressure. The multiplying effect is such that a speed of 3,000 revolutions per minute of the bur is attained.

A counterbalance is connected with the rocking arm by a chain, the links of which are caught over a hook or pin. By lengthening or shortening the chain the tension may be varied at pleasure; or the counterbalance may be so adjusted that the rocking arm will remain in any position in which it is placed.

The water motor is attached to the portable stand and swivels or turns in the top of the column. The frame of the motor carries the driving wheel to the trunnions of which the rocking arm is hinged. The supply and waste water-pipes are shown in the cut.

Petit, Electro-magnetic, * "*Scientific American*," xxxiv. 259.
Allen, Plugger, electric, * "*Telegraphic Journal*," iv. 209.

Den'tal File. These are very numerous, minute, and peculiar, adapted for plug finishing, for lateral and crown cavities, etc. See Fig. 796.

Fig. 796.

Murphy's Dental Files.

Den'tal Grind'stone. Grinding stones fastened on mandrels and made in a variety of forms for the delicate and minute operations of mechanical and operative dentistry.

They are made of Arkansas stone, Hindostan stone, or Scotch stone (Water of Ayr).

Fig. 797.

Dental Grindstones.

Den'tal Mal'let. 1. A small *hand*-mallet for striking the plugger in the operation of filling teeth.

A *live-blow* mallet is of steel.
Wood-cased mallets are of seasoned laurel or brier root, filled with metal a little harder than pure lead.
Metal-cased mallets are seamless tubes filled with lead, and give a *dull blow*. They are in sizes 3, 4, 6 ounces.
Tin mallets are made in sizes 1½, 2½, 3½ ounces
Composition mallets are of an alloy a little harder than lead.

2. An *automatic* hammer, operated by spring interiorly. See Figs. 1610, 1611, p. 686, "*Mech. Dict.*"; also Figs. 3835, 3836, p. 1749, *Ibid.*

3. An *electric* mallet, in which the impulse is given by electro-magnetism. See p. 1749, "*Mech. Dict.*," and instances cited. Fig. 3837, p. 1750, *Ibid.*

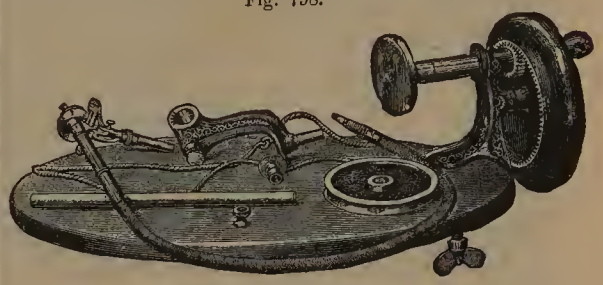
Spencer . . . . . * "*Scientific American*," xxxv. 18.

Den'ti-phone. An instrument for conveying audible pulsations of the air by way of the teeth to the bony structure of the head, and thus to the ear. See AUDIPHONE.

Den'tist's Lathe. A small table lathe adapted for turning, grinding, drilling, polishing, etc., in mechanical dentistry. The *dental engine* occupies the same relation in operative dentistry.

The apparatus shown in Fig. 798 will perform the duties of both laboratory and operative lathe. It is shown

Fig. 798.



White's Dentist's Lathe.

mounted as a lathe proper, but the parts are shown lying upon the table which, when mounted, constitute the apparatus as an engine or drill, having the functions shown in Fig 795.

De-ox'yd-ized Bronze. A mixture of copper and tin, compounded under certain conditions of proximate purity, and with a certain flux.

It is said to possess superior malleability, approaching gold alloys in this respect, while its tenacity and solidity are very great. It flows readily, is easily handled, and is capable of being re-worked. It is also receptive of a high, smooth finish; wears well, and is used for machine journals, car bearings, etc. It is now in use at the Philadelphia Mint.

De-phos'pho-riz-ing Pro'cess. (*Metallurgy.*) A process for the elimination of phosphorus from iron in the refining furnace.

Snelus, in England, patented in 1872 the use of lime or of limestone for the lining of furnaces, in which iron is refined while fluid.
Thomas & Gilchrist patented in 1879 a basic calcareous or magnesian lining for convertors, adding lime or oxide of iron and lime to the charge. See BASIC LINING.
The U. S. Patent of Jacob Reese is dated 1866.
Kunkel's U. S. Patent, dated 1866, claims the use of dolomite in the treatment of iron.
See also Hargreave's English Patent, 2461, of 1868.
See discussion in "*American Manufacturer*," June 6, 1879, p. 10, etc., and authorities therein cited.

Dep'i-la-tor. (*Surgical.*) An instrument, tweezers, for example, for pulling hairs.

Henry's depilating forceps . . . . . p. 2, Part II.
Cilia forceps . . . . . p. 2, Part II.
Tiemann's "Armamentarium Chirurgicum."

De-pol'ish-ing. (*Ceramics.*) A term applied to the process of removing the vitreous glaze from porcelain, and leaving it with the peculiar dull luster of the ordinary surface of ivory. It is known as ivory porcelain. Gold work ornaments show upon it with a fine effect.

The parallel process in glass working is called *deglazing*.

Lockert on . . . . . "*Technologiste*," xl. 51.

De-pos'it-ing Dock. (*Hydraulic Engineering.*) A caisson for raising vessels clear of the

water and depositing them on staging for examination, cleaning, or repairs, the caisson retiring to repeat the operation on other vessels.

The depositing dock of *Clark & Standfield*, of London, built for the Russian Government at Nicolaieff on the Black Sea, is shown in Plate IX. Its duty is to raise or lower vessels, to deposit them upon fixed timber staging and again remove them when required; also to lower into the water vessels built upon an even keel on such staging.

The staging on which the vessels are deposited consists of a number of parallel rows of piles driven into the ground in a direction transverse to the length of the vessel: the space between each row is clear and open and of sufficient width to receive the projecting pontons of the dock, which carry the vessel at a height somewhat above the top of the piles.

The pontons of the dock are tubular, parallel and fixed at one end to a longitudinal frame or floating girder; at the other end they are free so that the whole structure represents a comb, of which the pontons are the teeth and the girder the back. The dock is sunk beneath the vessel, and the water being pumped out the dock rises, carrying the vessel with it. It is then floated to the staging, the pontons entering into the openings between the stages, and the vessel itself with its gridiron and bilge-blocks being clear above them. A little water admitted into the pontons allows them to sink and deposit the vessel and its grid on the staging. The girder, to which the horizontal pontons are connected, and which form the floor of the dock, carries a row of hollow vertical cylinders of such a length that when the pontons are submerged beneath the vessel, the tops of the cylinders are a convenient height above water. A platform occupies the tops of the cylinders, and this vertical portion contains the engines, pumps, and valves for working the dock.

The stability of the structure is effected by an arrangement of parallel bars attached to a floating caisson at the back of the dock, so that while the dock is free to ascend or descend in the water it cannot move out of its horizontal position without capsizing the caisson, which is made sufficiently wide and heavy to render such movement impossible. The pontons have sufficient buoyancy to support the vessel without any assistance from the floating girder or vertical tubes. The latter are in fact carried by the girder.

Each of the pontons is divided into 6 independent water-tight compartments, irrespective of the compartments in the girder and vertical tubes, and the pontons vary in number in action from 15 to 30; the whole dock is divided into from 100 to 200 separate water-tight compartments connected with the pumps by independent pipes and valves. A number of compartments are horizontally sealed up, so that the structure cannot entirely sink even were the valves to be left open.

The dock is so constructed that it can be divided at mid-length into two halves, each provided with its own engine and pumps, and either part is capable of docking the other.

"*Engineer*" . . . . . * xlvi. 64; * 75.
"*Sc. Am. Supplement*" . . . . . * 392; * 661.

See also list under DOCK.

De-pres'sor. (*Surgical.*) A clamp or valve to hold an object out of the way during an operation.

Tongue depressor . . . . . Fig. 265 *b*, Part II.
Vaginal depressor . . . . . Fig. 246, 8, Part III.
Tiemann's "Armamentarium Chirurgicum."

Der-i-va'tion Reg'u-la'tor. (*Electricity.*) A form of *polyphote* regulator for voltaic arc lights in which the regulation is effected by the variations in the differences of potential in the lamp. There is but one regulating electro-magnet, with fine wire and *in derivation*.—"*Electrician.*"

The Gramme and Crompton regulators on the continuous current principle and the Mersanne, Gérard, and Lontin fed by alternating currents, are of the derivation order.

Der'ma-to-log'i-cal In'stru-ments. (*Surgical.*) Instruments for skin-grafting, etc. See *Tiemann's "Armamentarium Chirurgicum."*

Transplantation scissors . . . . . Fig. 291, Part I.
Nævus needle . . . . . Fig. 80, Part V.
Scarifying spud . . . . . Fig. 84, Part V.
Epilating forceps . . . . . Fig. 85, Part V.
Glass pleximeter . . . . . Fig. 90, Part V.
Piffard's needles . . . . . Figs. 82, 83, Part V.
Depilating forceps, etc. . . . . Fig. 7, Part II.

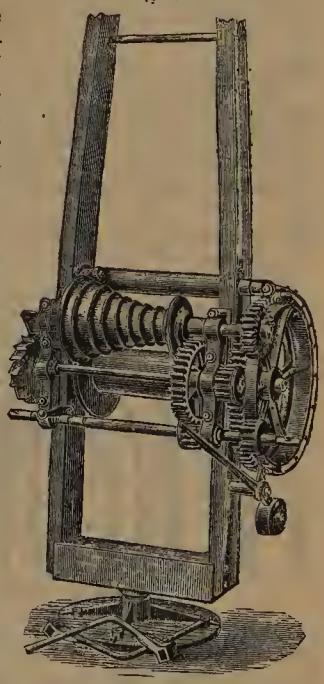
Dermopathic instruments are considered under ACUPUNCTURATOR, HYPODERMIC SYRINGE, SCARIFICATOR, LEECH ARTIFICIAL, DEPURATOR, CUPPING GLASS, etc.; also in "*Mech. Dict.*"

Der'rick. A species of hoisting apparatus: the term properly includes the machines which have an adjustable boom stayed from a central post which is held vertical by guys.

Mason . . . . . * "*Scientific Amer.*," xxxviii. 223.
Steam, *Lyman* . . * "*Am. Manfr.*," June 27, 1879, p. 13.
Revolving . . . . * "*Scientific American*," xlii. 114.

Der'rick Crab. The winch or hoisting arrangement at the foot of the leg of a derrick. The distinction made on p. 687, and elsewhere, "*Mech. Dict.*," being maintained—a *derrick* has one leg, with a swiveled post; a *shears* has two legs, a *crane* has a post and jib, or a curved jib which answers for both when a sufficient anchorage or base can be obtained to render a stay for the upper end of the post unnecessary; a *whim* has a vertical axis on which a rope winds and is moved by a horse sweep; a *capstan* has a vertical drum rotated by bars, etc.

Fig. 799.



Derrick Crab.

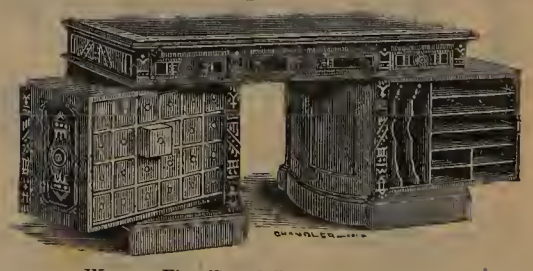
Fig. 799 shows one of Appleby's crabs for derricks, adapted to be run by hand cranks (not shown). The actual derrick shown is for 1½ tons and is erected in Columbo Harbor, Ceylon.

De-sil'ver-iz-ing Lead. A process used in reducing argentiferous galenas.

Lautenthal . . . . . "*Eng. & Mining Jour.*," xxx. 236.
Flach's zinc process . . "*Scientific American*," xxxvi. 233.
See also PATTINSON'S PORS, pp. 1638, 1639, "*Mech. Dict.*"

Desk. Figs. 800, 801, show a flat top office desk, the lower sections of which are pivoted to the

Fig. 800.



Wooton Flat Top Office Desk. (Open.)

frame-work of the body of the desk and can be rotated so as to expose the pigeon holes or shelves, or to hide and shut them. The cases are rotated by the turn of a key, and the whole interior space exposed to view.

The Stiles combined folding paper-rack with reading and writing desks was shown at the Centennial Exhibition, Philadelphia, 1876.

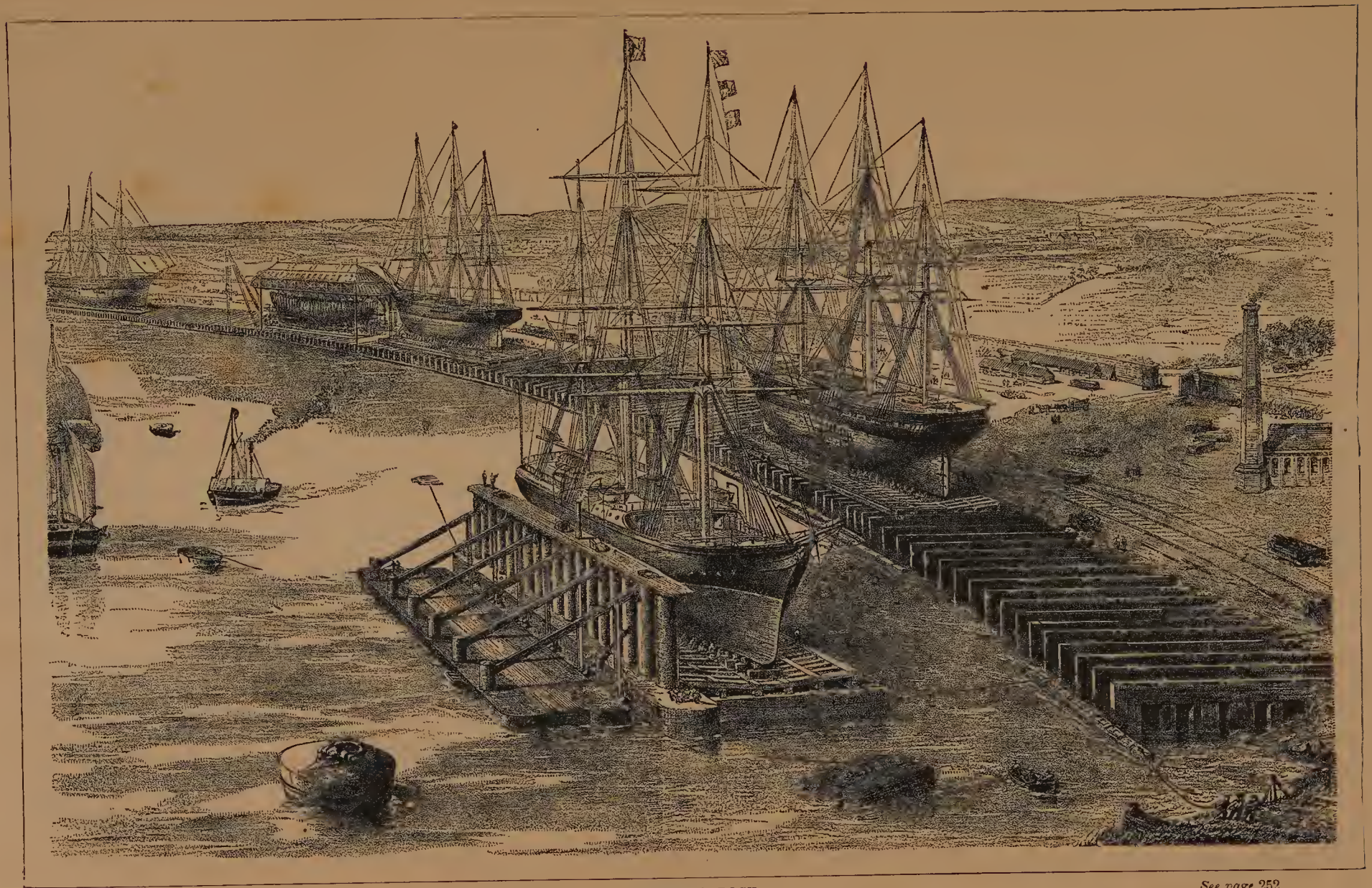


PLATE IX.

DEPOSITING DOCK.

See page 252

Fig. 801.

Wooton Flat Top Office Desk. (Shut.)

Atkinson . . . . . * "*Scientific American*," xxxiv. 246.
Stiles . . . . . "*Scientific American*," xxxv. 326.
Chair, *Taylor* . . . . * "*Scientific American*," xxxv. 294.
Satchel, *Kaplan* . . . * "*Scientific American*," xl. 323.

Des'si-ca-tor. An apparatus, in a laboratory, for promoting the absorption of the moisture of bodies. A porcelain dish with capsules or watch glasses, under a bell-glass, an absorber of moisture being included under the bell.

The term is also applied — somewhat inaccurately — to a similar inclosure to keep substances dry while weighing.

A *bain-marie*, or a sand-bath, may be used.

De-sul'phur-iz'ing Fur'nace. A roasting furnace for ores containing sulphur. See p. 690, "*Mech. Dict.*," and CALCINING FURNACE; DECOMPOSING FURNACE; ROASTING FURNACE, etc., *supra et infra*.

Willard . . * "*Mining & Scientific Press*," xxxvii. 145.

De-tach'a-ble Tooth Saw. Another name for the *insertable tooth* saw.

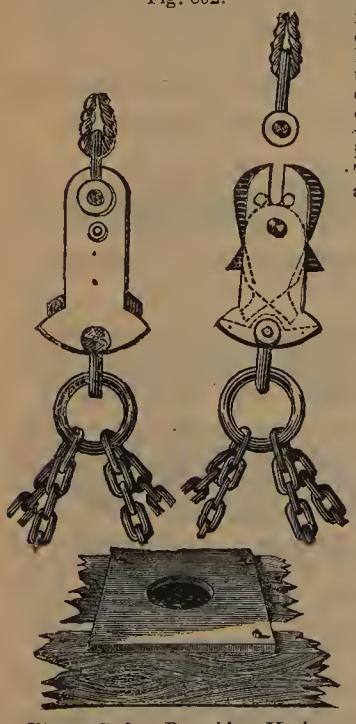
See 26 examples, Fig. 4593, p. 2035, "*Mech. Dict.*" Also as applied to stone saws, 20 examples in Fig. 5884, p. 2402. *Ibid.*

Brunet & Cochot's French patent, *Brevets*, vol. iv., Plate XV.

De-tach'ing Hook. 1. One for releasing the traces of a horse from the carriage. Referred to on p. 690, "*Mech. Dict.*"

2. One for casting loose the cage from the hoisting rope in case of overwinding in mine shafts.

Fig. 802.



King's Safety Detaching Hook.

King's safety detaching hook for mines and collieries, is shown in Fig. 802. It prevents the cage from passing over the wheel in case of overwinding, that is, when the steam-engine is not stopped in time. The figures show it as it appears at work, and as detached in the case of accident. Also the safety plate on which the cage remains suspended in case of becoming detached. 1500 of these hooks are said to be in use in British mines.

Fig. 803.

Cathcart's Detaching Hook.

3. One for releasing a boat from the davit tackle, as soon as the water is struck. Figs. 1596, 1597, p. 678, "*Mech. Dict.*"

Fig. 803 shows Captain Cathcart's detaching hook. It has a gravitating trigger which throws the ring out of the hook as soon as the weight is taken off the latter. The figure shows it in both conditions.

De-tect'or Gal-va-nom'e-ter. (*Electricity.*) A low resistance galvanometer used in testing condition of wires, etc., in laboratories and telegraph offices.

Dev'il's Claw. (*Nautical.*) A hook used to stopper the cable when the windlass is wanted for other uses.

De-vit'ri-fi-ca'tion. (*Glass.*) A process of subjecting glass for a long time to a high heat renders it opaque and hard like white porcelain.

Reaumur, in 1727, succeeded in the experiment by exposing it as described for 12 hours. It becomes extremely hard, acquires a noticeable fibrous structure, becomes a better electrical conductor. Glasses with a potassic base are more amenable to the process than those with a sodic base.

Bottle and window glass devitrify readily, and the contents of a pot in working will sometimes acquire the quality, losing its transparency.

Di'a-gnos'tic In'stru-ments. (*Surgical.*) Those for exploring, to ascertain the condition, natural or morbid, of parts.

The list embraces the following. They may be found in the specific lists (surgical), and under their specific titles, *infra* and in "*Mech. Dict.*" Also in Part I., *Tiemann's* "*Armamentarium Chirurgicum*," on the pages noted: —

Clinical thermometers . . . . . Page 75.
Urinary examination apparatus . . . . Page 77.
Auscultation instruments, stethoscopes, plexímeter, and percussor . . . . . Page 81.
Stethometer . . . . . Page 84.
Cystometer . . . . . Page 84.
Cardiameter . . . . . Page 84.
Æsthesiometer . . . . . Page 85.
Sphygmometer . . . . . Page 87.
Hæmarheumoscope . . . . . Page 88.
Dynamometer . . . . . Pages 88, 285.
Piezometer . . . . . Page 88.
Microscope . . . . . See *infra*.

Di'a-gom'e-ter. Palmieri's diagometer is an instrument designed to test the quality of oils, and is based upon the principle that olive oil is a poorer conductor of electricity than any other oil in common use. The oil is poured into a glass vessel, into which dip two brass rods which are kept the same distance apart while experimenting with different oils which are in succession poured into the glass. An electroscope determines the relative conductivity of the oils as the electricity passes from point to point through the oil.

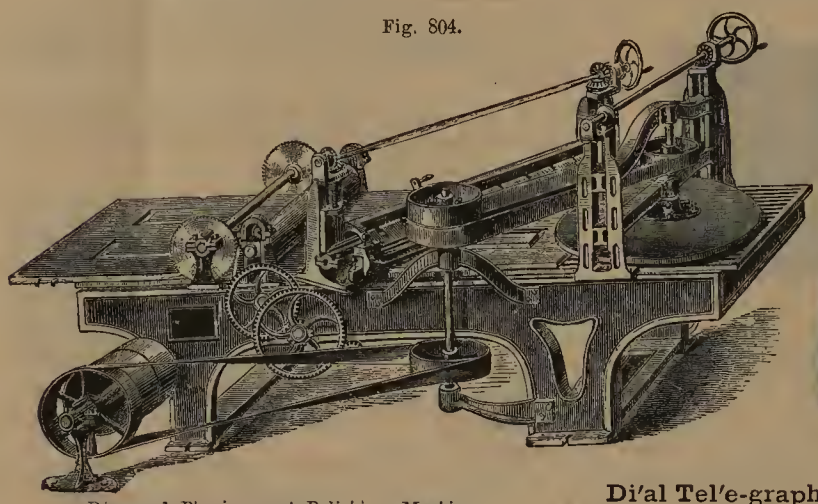
The instrument may also be employed to detect the presence of cotton in silk fabrics. — *Professor Ricco.*

"*Scientific American*" . . . . . * xxxix. 185.

Di-ag'o-nal Pla'ner. A wood-planing machine in which the planing cylinder has an oblique position relatively to the line of motion of the stuff under treatment. The machine is especially intended as a substitute for hand-planes in making doors, frames, blinds, etc. A door is shown as passing through the machine, beneath the feed-roller, then under the diagonal planing cylinder, and then below the polishing disk. Fig. 804.

"*Mining and Scientific Press*" . . . . * xxxv. 49.
"*Manufacturer and Builder*" . . . . * x. 151.

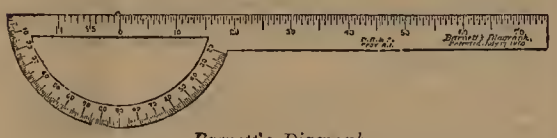
Fig. 804.



Diagonal Planing and Polishing Machine.

Di'a-graph. A platting instrument, combining a protractor and scale.

Fig. 805.



Barnett's Diagraph.

Dial. A graduated circle with numbers or point marks.

See illustrated article "*Cadrans Solitaire*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877.

One found at Tusculum * "*Scientific American Sup.*," 4098.
Self recording, *Davis* . * "*Scientific American Sup.*," 616.
Self registering sun, Br. "*Scientific American*," xxxvii. 97.
Illuminated . . . . "*Scientific Amer.*," xxxix. 402.
Luminous watch . . . "*Scientific Amer. Sup.*," 2822.

(*Add.*) 6. (*Mining.*) A compass for taking bearings in mines.

7. (*Lock.*) The lettered or numbered face-plate of a permutation lock.

8. Various modes have been proposed and some of them put in practice for illuminating dials and signs at night.

Recordon's plan for watch dials is to place a Geissler tube containing a gas which gives a brilliant light in front of the dial. A battery about the size of a thimble is attached as an ornament to the watch chain. To consult the watch, press a spring and the current passes and illuminates the dial. The battery lasts a year in operation.

A plan for an illuminated public clock dial, is to employ a magic lantern to throw the picture of a common watch upon a suitable white screen in a public place.

Illumination of a town clock dial by gas in the rear of the glass dial plate is common; also by reflected light, p. 1171, "*Mech. Dict.*"

Phosphorescent paints for luminous dials and signs: —

1. Heat strontium theo-sulphate for 15 minutes over a Bunsen lamp and then for 5 minutes over a blast lamp.

Or 2. Heat equal parts of strontium carbonate and lac sulphuris gently for 5 minutes and then strongly for 25 minutes over a Bunsen lamp, and then over a blast lamp for 5 minutes.

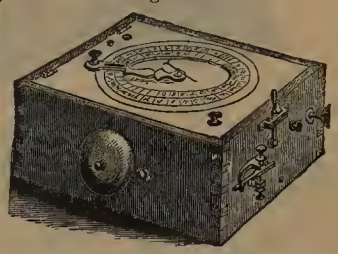
Or 3. Precipitate strong aqueous solution of strontium chloride by means of sulphuric acid; dry the precipitate and heat to redness for some time in a current of hydrogen. Then over a Bunsen lamp for 10 minutes, and 20 minutes over a blast lamp.

Mix either of these with pure paraffine for use as a paint and expose to sunlight.

1 and 2 give greenish phosphorescence; 3 a bluish phosphorescence.

The luminous clock dial of M. Balmain, of Paris, is painted with a composition into which enters a phosphorescent salt; storing up the light of day to give it out at night. Sulphide of calcium in varnish is stated as the preferable agent.

Fig. 806.



Dial Telegraph.

Di'al Tel'e-graph. A simple form of telegraph adapted for the use of persons who do not know the special systems or alphabets. It is only necessary to move the handle to any letter or number on the dial and a delicate needle in a corresponding instrument will point to the same letter. The needle of the receiving instrument is shown in the center of the dial, the sending handle on the exterior. The needle of the receiving apparatus passes through the center of the hollow shaft of the transmitting apparatus, and the same dial answers for both. A call-bell is attached to the instrument.

Di-al'y-sis Ap'pa-ra'tus. An apparatus consisting of a large flask with a faucet, a series of glass funnels and connecting siphons, and a final receiving vessel. Each funnel has a plaited filter made of parchment paper.

The process is described and the apparatus represented in "*Journ. de Pharm. et Chim.*" Reproduced in "*Scientific American Supplement*," * 2672.

Di'a-mag-net'ic. (*Electricity.*) A term applied to substances like glass, resin, bismuth, the poles of which tend to move from the strong to the weak places of electro-magnetic force. — *Gordon.*

Dia'mond. Mechanical uses of the diamond are noted in the following references: —

Millstone dresser, *Millot* * "*Engineer*," xlvi. 255.
Drill (Pa. Co.) . . . . * "*Scientific American Sup.*," 495.
Boring machine,
Penn. Diam. Drill Co. * "*Engineer*," xli. 447.
Mounting tools,
Millot Switz . . . . * "*Engineer*," xlvi. 255.
Stone-saw, *Emerson* . . * "*Min. & Sc. Press*," xxxiv. 177.
Technical uses of . . . "*Iron Age*," xviii., Dec. 14, p. 5.
See also pp. 696, 697, "*Mech. Dict.*"

Dia'mond, Ar'ti-fi'cial. A gem made of a clear white strass.

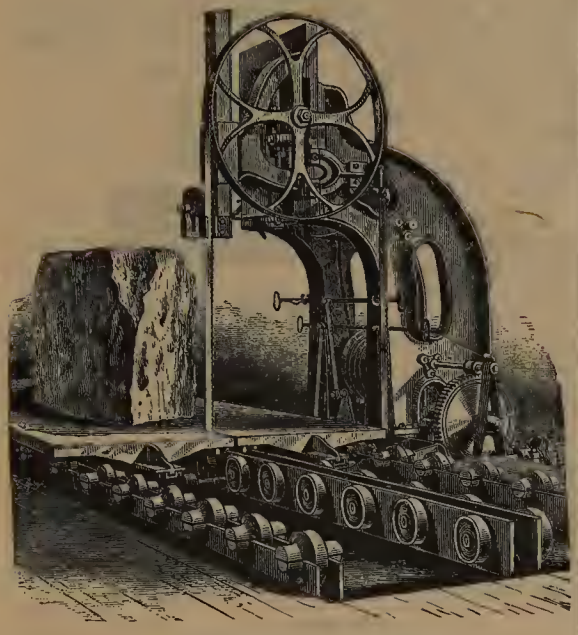
Loysel's paste:	Pure silica	100
	Red oxide of lead	150
	Potash, calcined	30
	Borax, calcined	10
	Arsenious acid	1

The paste has great brilliancy, refractive and dispersive powers and a specific gravity similar to that of the oriental diamond. It fuses at a moderate heat, and acquires great brilliancy by keeping in a fused state for several days to expel the superabundant alkali and perfect the refining.

Dia'mond Band'-saw. An application of the band-saw to the cutting of stone. The endless blade is set with diamonds and propelled by mechanism, which at the same time moves a bed-plate carrying the material to be sawn.

For sawing curves and scrolls narrow blades are used. The feed is made variable according to the kind of stone and its thickness. On one occasion, at the American Institute Fair, it sawed a block of

Fig. 807.



Diamond Band Stone-cutting Saw.

Newark brownstone, 3′ 2½″ × 3′ 3″, a superficial area of cut of 1,501½ sq. inches in 22 minutes.

For circular stone saw see Fig. 5883, p. 2401, "*Mech. Dict.*"

Dia'mond Pan'eled Stone Work. (*Stone Cutting.*) Stone ashlar with the margin tooled and the face rising gradually in four triangular planes to an apex at the center.

The *sunk* diamond panel has a sunken margin, while the *raised* diamond panel starts immediately from the inner line of the usual tooled margin.

Dia'mond Stone Saw. A saw furnished on its edge with diamonds and used in cutting stone.

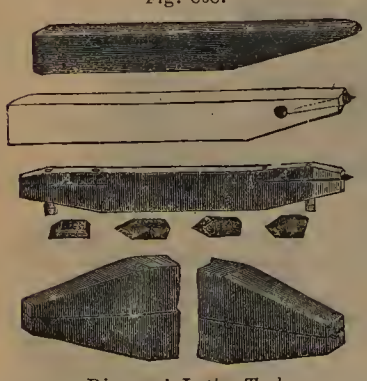
See DIAMOND BAND SAW, Fig. 807; STONE SAW CIRCULAR, Fig. 5883, p. 2401, "*Mech. Dict.*"

Young's diamond reciprocating stone saw. *Hinton's* Report, "*Vienna Exposition Reports*," 1872, vol. iv., section D, p. 16.

Willard, Whittier, & Co's. diamond saw quarrying machine. *Ibid.*, p. 17.

Dia'mond Tool. 1. A tool which has a diamond mounted in a handle or holder and used to dress and turn up emery wheels, grindstones, hardened steel calender rolls, etc.

Fig. 808.

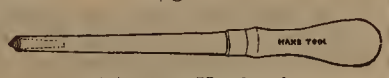


Diamond Lathe Tools.

2. For forms of carbon points, see Fig. 1098, p. 461, "*Mech. Dict.*"

Fig. 808 shows diamond holders in which carbons are set permanently or in adjustable stems for the purposes above expressed. The lower figures in the cut show Dickinson's patent clamp.

Fig. 809.



Diamond Hand-tool.

Fig. 809 is a diamond hand-tool.

Dia'mond Truck. (*Railway,*) A car-truck with iron side-frames which are diamond-shaped. The journal-boxes are rigidly bolted to the sides, and have no vertical motion in the frame. See figures on p. 489, "*Mech. Dict.*"

Di'a-nem'o-scope. An instrument invented by M. Stanek, and having for its object the analysis of the more complicated motions of a double slide-valve system.

Proceedings of the "*Institution of Architects and Engineers in Bohemia.*" Reported in "*Engineering*," * xxiii. 420.

* "*Scientific American Sup.*," 1332.

Di'a-pa'son Clock. A form of clock made by Breguet, of Paris, in which a diapason (tuning-fork), is substituted as a regulator in place of a pendulum or spring balance-wheel.

* "*Reports of Artisans at Paris Exposition to the London Society of Arts*," p. 361. (Published by Bell & Bately, London, 1867.)

Di'a-pho-nom'e-ter. An instrument used in testing spirits (*Savalle*, Fr.). By it is determined the relative transparency of the sample when the reactive principle is added to the spirit. The degree of transparency preserved is the measure of the purity, and the comparison is made by the eye, the sample being held alongside specimens of determinate quality. * "*Technologiste*," xl. 169.

Di'a-phragm Fur'nace. (*Metallurgy.*) A roasting furnace in which ore is treated while dropping from one to another of a series of diaphragms in a vertical shaft. — *Haskins.*

Di'a-phragm Valve. One which closes by the pressure of a diaphragm against an opening, and *vice versa*. See Fig. 1636, p. 698, "*Mech. Dict.*"

Fig. 810 shows the principle adapted to a ball valve, where the ball floating in a cistern or boiler closes the water-induction opening on arriving at a certain height in the cistern.

Fig. 810.

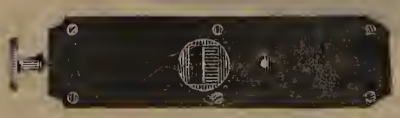
Diaphragm Ball Valve.

Another form of diaphragm valve is that in which a diaphragm expanded or extended by steam or air becomes the means of moving a valve, as in some forms of damper and steam regulators.

Di'a-tom Prism. (*Optics.*) An equilateral prism fitting under the stage of the microscope, and brought in contact by means of water or oil with the back surface of a slide upon which an object is mounted, enabling a very oblique angle of light to be transmitted through the slide.

Di-chro'i-scope. (*Optics.*) An appliance used

Fig. 811.



Sorby's Dichroiscope.

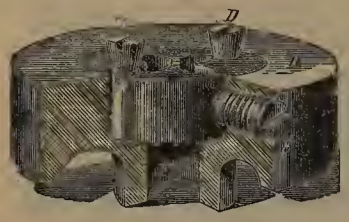
with a double image prism to give the complementary colors of an object examined under the microspectroscope. See Fig. 1640, p. 699, "*Mech. Dict.*"

Die. A hollow screw-cutter for cutting threads, in bolts, etc.

Fig. 812 is Wiley & Russell's adjustable die. *A* is the die

proper; *B*, the collet or holder; *D*, taper-head screws which govern the size of the cut; the points of these screws hold in a rim at the bottom of the socket; *E*, binding screws which close the dies together from the sides and hold them firmly; *F*, guides for bolts being threaded.

Fig. 812.



Wiley & Russell's Adjustable Die.

Fig. 813 is the Pratt & Whitney die. It consists of four chasers inserted in radial recesses in an iron disk or collet, encircled by a heavy wrought-iron ring, with adjusting screws. Each chaser is beveled in the ring, and is grooved on one side to receive the hardened point of a screw that is inserted in the collet to hold it firmly in position. Four screws extend up through the central flange of the collet, two of which serve to draw down the ring and move the chasers simultaneously toward the center to reduce the cutting size of the die, the other two screws hold the ring in the desired position or force it upward to enlarge the die.

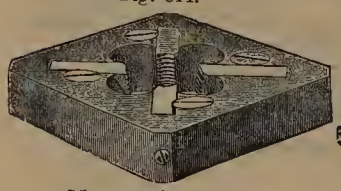
Fig. 813.

Pratt & Whitney's Adjustable Die.

The chasers, when dull, can be slipped out and ground on an ordinary grindstone, and be thus sharpened till worn out.

Fig. 814 is the Morse adjustable die. The die is fitted with chasers which are readily adjusted to take up wear or any variation in the size of the pipe. They can be sharpened when dull by grinding. The parts are made interchangeable.

Fig. 814.



Morse Twist Drill Co. Adjustable Die.

Fig. 815.

Morris Tasker & Co. Screw Die.

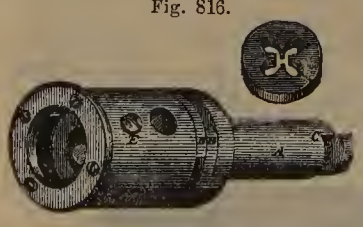
Fig. 815 is the Morris, Tasker & Co. die, with six chasers set up by screws. It is to be used in the head of their screwing machine.

See, also —

Nozzle tempering, *Harmstead* * "*Scientific Amer.*," xl. 307.
Stock, *Walker & Williams* . . * "*Engineer*," l. 420.
"*Scientific Am.*," xliii. 230.
Lead pipe press . . . . . * "*Man. & Builder*," ix. 173.
Ore stamps . . . . . * "*Scientific Am. Sup.*," 1512.

Die Hold'er. A head clutch or clamp for dies in a stock, brace, or machine. It is a form of chuck, the obverse of the drill chuck, shown on p. 276, *infra*.

Fig. 816.



Die Holder.

Fig. 816 is *Brown & Sharpe's* die holder for use in the revolving heads of screw machines, especially where it is desirable to cut the thread up to a shoulder or to a given point, or to run the tap into a shoulder for a given distance only, and this is necessarily a delicate operation, requiring expertness to avoid breaking the threading tool or injuring the shoulder of the screw. The engraving represents a patented device to remedy this difficulty, without regard to the skill with which it is operated.

Fig. 817 shows a solid die and die holders of the *Morris Tasker & Co* screwing machine.

Di'e-lec'tric Ma-chine'. A simple and powerful static conduction machine constructed by M. Carré. It has revolving wheels of hardened rubber, the electricity being supplied by friction on stationary rubbers placed in front. It is a machine of singular power and capacity as evinced in the production of sparks, illumination of Geisler tubes, piercing of glass and charging batteries of Leyden jars.

Abbe le Dantec.
* "*Sc. Am. Sup.*," 3902.

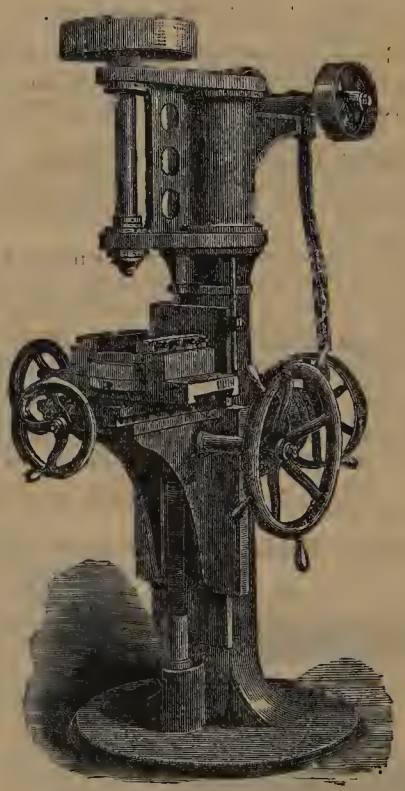
Fig. 817.

Die Holders for Screwing Machine.

a. Solid die.
b. Solid die holder for use in head of screwing machine.
c. Reducing pieces for holding square dies.

Die-sink'ing Ma-chine'. In principle this machine is similar to the profiling machine, but it has a far greater range. The work may be moved in all directions, and may be guided by a pattern or controlled by the hand of the operator. It is well adapted to forming recesses of a circular, annular, or irregular shape; works very smoothly and free from chatter. The various feeds are entirely independent.

Fig. 818.



Die-sinking Machine.

The work to be operated upon is held in the vise, which may be moved in all directions horizontally by compound slides on the table of the machine, and may be elevated or depressed by the vertical movement of the platen. The cutter, which may be of any suitable size or form, revolves with the spindle which is driven by a belt, giving much smoother action than is possible with gears. The greatest distance between the end of the spindle and top of the table is 24″. The platen has a vertical adjustment of 16″, and the horizontal movements of the vise are 10″. The countershaft has two sets of pulleys, giving two speeds, which may be varied on the spindle by a cone with three grades.

Di'e-ther'o-scope. An instrument invented by *M. Lurini* for measuring the variations in the refractive condition of the atmosphere.

"*Scientific American Supplement*" . . . * 477.

Dif'fer-en'tial. (*Electricity.*) A coil of electrified wire having such relation to another electrified coil or to an armature (or needle) common to both as to produce polar action contrary to that produced by such other coil.

(*Electric Lamps.*) A conductor of high relative resistance — used with electric lamps in series, — which operates in the twofold capacity of shunting surplus current to the next lamp and of shortening the arc of its own lamp, so as to maintain equal action in all lamps of the series. (See ELECTRIC LAMPS.)

Dif'fer-en'tial Ap'pa-ra'tus. See under the following references and the articles *infra*. DIFFERENTIAL PULLEY, etc.

Thermometer, *Dufours* . . . . * "*Sc. Amer. Sup.*," 3952.
Pump, *Hathorn, Davis & Co.*, Br. * "*Engineering*," xxvi. 197.
Screw Jack . . . . . * "*Engineering*," xxv. 522.
Wheels, C. W. MacCord . . . * "*Sc. Amer. Sup.*," 2123

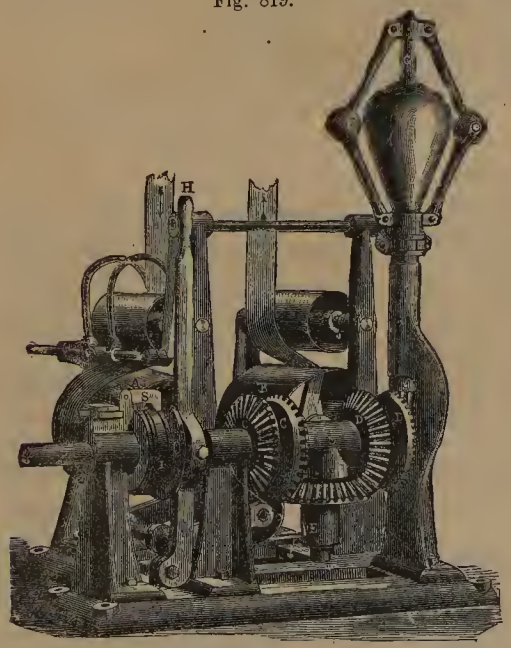
Dif'fer-en'tial Gal'va-nom'e-ter. (*Electricity.*) An apparatus consisting of a needle as in an ordinary galvanometer, but round the frame of which are coiled two wires of the same kind and dimensions carefully insulated from one another; separate currents being passed through them in opposite directions, the needle by the direction and extent of its disturbance indicates which current is the stronger and in what degree.

Dif'fer-en'tial Gov'er-nor. A water-wheel governor. The motion is positive, the revolving balls are merely indicative of the speed of the motor and are not regulators.

The operation of the governor is as follows: —

Two pulleys, *A* and *B*, are geared respectively to *C C* and *D D*. Pulley *A* is the frustum of a cone, its diameter at the center of its face being the same as that of the regular pulley *B*. The gears *C C* and *D D* are loosely set on the shaft *F*. The gear marked *E*, enters into *C* and *D*, and is loose on a stud which is fastened to the shaft *F*. The shaft carrying the pulley *A* has upon its end a small gear (not shown in the engraving) which communicates motion to the

Fig. 819.



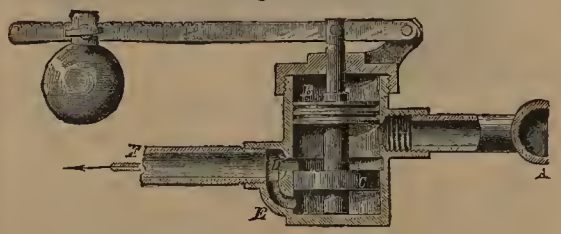
Weaver's Differential Governor.

gears *C C*. Upon the end of the shaft carrying the pulley *B* is a similar small gear (not shown in the engraving), which gives motion to the gears *D D*. Motion is communicated to pulleys *A* and *B* by a belt running in the direction indicated by the arrows. On the lower end of the governor shaft, *G*, is a small gear, which receives its motion from the gear *D*. When the belt is running in the center of the two pulleys *A* and *B*, the speed of both is the same, as their diameter in the center of face is the same. Consequently *C C* and *D D* run at the same speed, and have an equal action on the gear *E*; and hence the stud upon which the gear *E* revolves is held stationary. Now, upon the addition of a load, the speed will be checked, and the balls of the governor will fall. By this act, the belt on pulley *A* is, by proper connections, moved towards the larger end of the cone, thus causing the gears, *C C* and *D D*, to revolve with unequal velocity. This motion of the gears causes the gear *E* to be carried around on the gears *C C*, which, by means of connections with the shaft, opens the gate. Upon the decrease of the load, this operation is reversed, and the gate shut. The purpose of the lever *H* is to throw the governor out of gear by means of the flange *O*, and the clutch *I*. The flange is held out of gear by the latch marked *S*. The object of this arrangement is to enable one to hoist the gate, and when the proper speed is attained to throw the governor into gear by lifting the latch *S*.

Dif'fer-en'tial Move'ment. For the principles and illustrative instances of the transference of a movement at different rates in other directions, conversion of movements, etc., see "*Differential*," *Laboulaye's "Dictionnaire des Arts et Manufactures,"* Paris, 1877, vol. i.

Dif'fer-en'tial Press'ure Reg'u-la'tor. A contrivance to enable steam to be taken from a

Fig. 820.



Hand's Differential Pressure Regulator

boiler or steam-pipe at any initial pressure and delivered equally at any pressure for which it is set.

Steam is taken from pipe *A* and passes to the chamber where it acts equally upon the apposed surfaces of *B* and *C*, being so far balanced. The steam, however, passes by duct *D* beneath the piston *C* and exerts an upward pressure; this is balanced by the weight on the lever which tends to depress *C*. If the steam pressure should rise above that for which the lever ball is adjusted, the steam will raise *C* and partially close duct *D*, so that the *quantity* of steam passing to the object to be heated is diminished in proportion to its increased pressure and heat.

Fig. 821.

Differential Pulley Block.

Dif'fer-en'tial Pul'ley Block. Fig. 821 shows the Moore's improved form of differential pulley block as manufactured by the Providence Tool Co. It has the following features: —

The lifted weight cannot run down of itself when suspended; both chains take an equal share of the load, so that the block hangs plumb; a hook can be attached to each end of the lifting chain so that when one load is raised the other hook is in position ready for work.

Weston . . . . . * "*Iron Age*," xxi., Jan. 17, p. 1.
Weston . . . . . * "*Scientific American*," xlii. 351.
Weston . . . . . * "*Min. & Scientific Press*," xxxvi. 225.
Cherry . . . . . * "*Engineer*," xlii. 33.

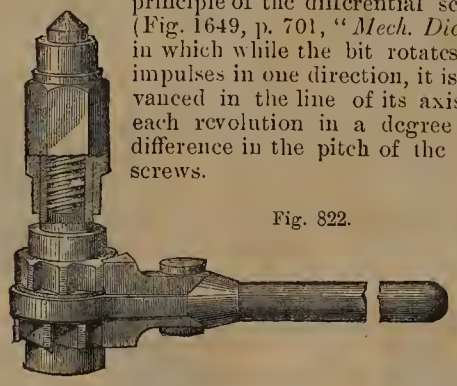
Dif'fer-en'tial Pump. In Davey's steam pump (Hathorn, Davis and Davey, Leeds, England), the slide valve derives its motion both from the main cross head and from a rod connected with a

cataract piston moving with a uniform velocity, the two motions being so connected that the cut-off depends upon the velocity of motion of the main cross-head — in other words, upon the resistance encountered or work to be done by the piston. In the differential pumping engine the cataract piston is connected with a subsidiary steam piston working in a separate cylinder fitted with a small slide valve.

The invention is shown and described in
"*Scientific American Sup.*" . . * 2369.
Hathorn, Davis & Co., Br. . . * "*Engineering*," xxvi. 197.

Dif'fer-en'tial Ratch'et Brace. One on the principle of the differential screw (Fig. 1649, p. 701, "*Mech. Dict.*") in which while the bit rotates by impulses in one direction, it is advanced in the line of its axis at each revolution in a degree the difference in the pitch of the two screws.

Fig. 822.



Differential Rachet Brace.

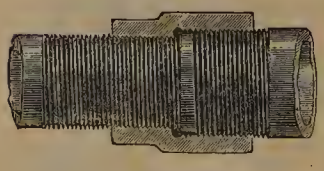
See also RATCHET-BRACE, RATCHET-DRILL, p. 1882, "*Mech. Dict.*"

Dif'fer-en'tial Reg'u-la'tor. (*Electricity.*) A means of regulating an arc voltaic light, in a polyphote arrangement, by the differential action of the main current that produces the voltaic arc and of a highly resistant derivation established between the two carbons; thus, their distance apart depends both on the intensity of the current and on the difference of potential at the base of the two carbons; and equilibrium is established for each lamp, when the intensity and the difference of potential have reached the point requisite for the good working of the lamp. "*Electrician.*"

The *Siemens'* differential lamp has two solenoids that work on one rod. The *Brush* and the *Weston* have one electro-magnet on which are coiled two wires that act in inverse directions.

Dif'fer-en'tial Screw Pipe Joint. A pipe joint, the invention of M. Brurry, of St. Gallen, Switzerland. The ends of the pipes to be connected are threaded with screws of a different pitch and respectively right and left handed. A coupling, correspondingly threaded, screws on to them simultaneously and draws them together with great force.

Fig. 823.



Differential Screw Pipe Joint.

Bourry, Switz. . . . . * "*Engineering*," xxiii. 388.
* "*Scientific American Sup.*," 1272

Dif'fer-en'tial Steth'o-scope. (*Surgical.*) A double stethoscope with elastic tubular branches and bells capable of being applied to different portions of the thorax so as to compare the indications at different points.

Allison, Fig. 268, p. 83, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

Die Dog. A lathe dog adapted to hold a screw cutting die. Fig. 824.

Dif-fu'si-om'e-ter. (*Gas.*) An instrument invented by Graham to ascertain the rate at which diffusion of gases among one another takes place.

A glass tube of 1″ caliber, 1′ in length, is stopped at one end with a porous plug of gypsum or graphite. The tube is filled with hydrogen, for instance, the open end plunged in a bath of mercury, and diffusion takes place through the plug. The law that the diffusibility of gas is in proportion to the square root of their densities is illustrated by the intercharge of hydrogen and atmospheric air, at the expense of the latter, and the tube is eventually emptied.

Fig. 824.

Die Dog.

Dif-fu'sion. (*Electricity.*) The power of a galvanic current to extend its influence in all directions, that influence being never limited to the two electrodes.

Dif-fu'ser. A portion of the apparatus in Clamond's thermo-electric battery, consisting of a series of plates of copper placed all round the battery, and which effect the removal and rapid dispersion of the heat of the solderings by means of the great surface which they present.

Described in "*La Nature*," 1880. Also in "*Manufacturer and Builder*," * xii. 86.

Dif-fu'sion Pro'cess. The Roberts diffusion process is mentioned and illustrated on p. 702, "*Mech. Dict.*" It has been very elaborately extended in some European sucreries. See

Roberts, Fr. . "*Dept. Agric. Sp. Rep.*," No. 28, Pl. XXIII.
Rotative, Ger. . "*Dept. Agric. Sp. Rep.*," No. 28, Pl. XXIV.
Continuous process.
* "*Scientific American Sup.*," 4109.

The question is admirably discussed, compared, and illustrated in Mr. Mallet's report on Group III. at the International Exhibition, Philadelphia, 1876. See vol. iv., Group III., * pp. 20–54.

The rotative diffusion apparatus was shown at the Paris Exposition of 1878 by Leeomte & Villette, Saint-Quentin (Aisne), France.

See also pamphlet on the subject by G. Bouscaren, Cincinnati, O.

Dig'ger. A spading machine.

Steam, *Darby*, Eng. . . * "*Scientific American Sup.*," 2458.
Knight, Br. . . . . * "*Engineer*," xli. 394.
* "*Scientific Amer.*," xxxviii. 83.
* "*Scientific American Sup.*," 455.

Dike. 1. A levee, bank, or dam.

In Japan the dike is formed thus: A kind of strong cylindrical bag, often eight yards and more in length, is made of split bamboo, with wide meshes, and is then filled up with big stones. A certain number of these bags, arranged on a wooden grating, form the foundation of the breakwaters or dikes. When the current is very strong, the ends of the bags are allowed to pass the gratings and to hang down into the sandy bed of the river; gradually they sink deeper and deeper, and finally, being entirely buried in the mud, form a solid mooring. The object of the bags is to keep the stones together, till all the interstices are filled up with sand and mud, when the construction is transformed into a solid mole. The bamboo is said to be of great durability; stems of this tree are also used for weirs and the temporary surroundings of breakwaters. The exterior parts of dikes are often covered with grass matting, so as to prevent their being washed away.

2. (*Mining.*) A wall-like mass of mineral matter filling fissures.

Di-la'tor. (*Surgical.*) An instrument for distending a natural or artificial opening. The term is specially applied to certain instruments, but really includes *speculi*. See Figs. 5360-5363, p. 2260, "*Mech. Dict.*"

See also list of DILATORS, p. 703, *Ibid.*, and ENDOSCOPE, *infra*.

The subject may be pursued by reference to the following figures in *Tiemann's* "*Armamentarium Chirurgicum*": —

Lithotrity . . . . Page 43, Part III.
Meatus urinarius . . Page 2, Part III.
Esophageal . . . . Page 84, Part II.
Rectal . . . . . Page 118, Part III.
Sponge . . . . . Page 14, Part V.
Tracheal . . . . . Pages 93–94, Part II.
Tupelo . . . . . Page 11, Supplement.
Urethral . . . . . Page 23, Part III,
Uterine . . . . . Pages 77–79, Part III., 13, Supp.
Vagiual . . . . . Page 66, Part III.

Di-la'ting For'ceps. (*Surgical.*) Forceps the prongs of which are used to expand a passage or meatus. The *cervix uteri* dilator, for instanee, Fig. 1220, p. 516, "*Mech. Dict.*," *et infra.*

Di-men'sion Saw'ing Ma-chine'. One adapted to sawing stuff to a given size for manufacturing purposes.

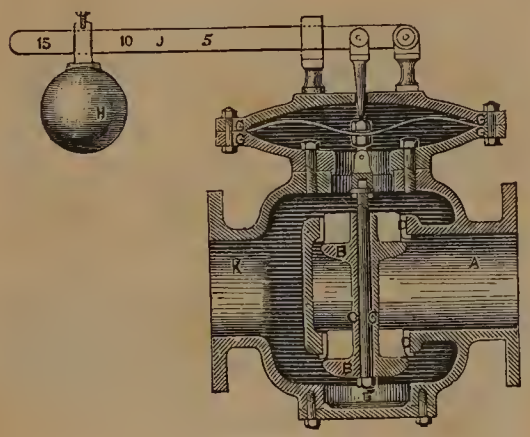
Richards' . . . . . * "*Engineering*," xxv. 151.
Preston's . . . . . * "*Scientific American*," xl. 403

Di-men'sion Stone Work. (*Masonry.*) Said of masonry when the dimensions of the stones entering into it are fixed by specification. See list under MASONRY.

Di-min'ish-ing Valve. A valve to regulate high pressure steam so as to give out a constant and uniform supply of low pressure steam.

The valve is shown by section in Fig. 825. Its operation is as follows: *A* is the inlet for high pressure steam; *BB* is

Fig. 825.



Diminishing Valve.

a double beat valve, with a hole through the stalk *C*, and which shuts against the brass seatings *BD*; *E* is a connecting rod, secured with nuts and washers to the bottom of the valve *BB*, and also to the circular corrugated metallic disk *F*, which is held in position betwixt *G G*. Suppose there is a pressure of 60 lbs. per square inch at the inlet *A*, and 10 lbs. per square inch is required at the outlet *K*, set the weight *H* on the lever *J* at 10 lbs., which pressure will raise the corrugated metallic disk *F*, thereby shutting off the excess of steam over and above the 10 lbs. required. The pressure at the outlet may be varied by moviug the weight *H* on the lever *J*.

Din'gy. (*Fishery.*) A small fishing boat. See list under BOAT.

Berthon's duplex dingy, Br. . . * "*Engineer*," xlix. 438.

Di-o-nys'i-us' Ear. An aural instrument for the very deaf. It has a capacious pavilion swiveled on a stand which is planted on the floor, and an elastic tube with a nozzle to be applied to the ear.

Fig. 227, Part II., *Tiemann's* "*Armam. Chirurgicum.*"

Di-op'tric Ap'pa-ra'tus. The refraction system of lighting as distinguished from *catoptric*. See p. 704, "*Mech. Dict.*" See also following instanees: —

Little-Basses, Ceylon . . . . * "*Sc. American Sup.*," 945.
For electric light, *Henderson*, Br. . . . . * "*Engineer*," xlix. 246.
Flashing apparatus, Little-Basses light . . . . . * "*Engineering*," xxii. 355.
For light-ships, *Sautter, Lemonnier & Co.*, Fr. . . . . * "*Engineering*," xxvii. 211.
Revolving light, *Sautter, Lemonnier, & Co.*, Fr. . . * "*Engineering*," xxvii. 269.

Di-or-rex'ine. An explosive analyzed by M. Fels.

Consists of Picric acid, 1.5	Nitrate potassium .	60
Wood charcoal . . 7	Nitrate sodium . .	
Birch sawdust . . 10	Sulphur	12
	Water	9.5

Made principally at Brunn and Trieste.
"*Eng. & Mining Journal*," xxviii 263.

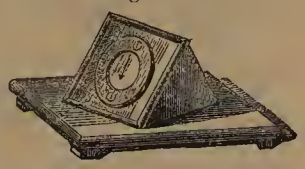
Another published recipe gives: —

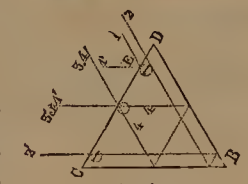
Nitrate of potassium	50
Nitrate of sodium	25
Sulphur	12
Hard wood sawdust	13
	100

Di-plei'o-scope. An instrument invented by Bloxam to determine true meridian. *Dipleidoscope*, p. 704, "*Mech. Dict.*"

The instrument is represented in Fig. 826, the upper view showing it in position for observation, and the lower a diagram illustrating the principle of its operation, which is founded on the property of polished bodies, to reflect rays at an angle equal to that of their incidence.

Fig. 826.





Dipleioscope.

The instrument is on a horizontal base, and its anterior face is perpendicular to the meridian of the place. It is an equilateral glass prism with one face exposed, the others being opaque and constituting mirrors. *D C* represents the exterior face of the instrument, and *D B*, *B C* are mirror planes. Suppose that the ray 1 striking *D C* at *E* be reflected towards the eye in the direction 1′, the image of the sun will appear, as time lapses, to advance in the direction from *D* towards *C*. The ray 2, traversing *D C*, is reflected by *C B* on to *D B*, and thence towards the eye in the direction 2′, aud the second image of the sun has an apparent motion iu the direction from *C* to *D*, and as the sun culminates the two images mutually approach.

Supposing that the ray 1 shall arrive at 3 and the ray 2 impinge upon 4, it is evident that they will be each reflected in the common direction 3′ and 4′; that is to say, that the two images will coincide at the instant of true meridian. The moment passed, the rays continuing to advance, the images again separate themselves, changing their relative positions and mutually recede.

Dip'lo-graph. A writing apparatus for the blind, invented by M. Recordon, of Geneva, Switzerland.

Speaking in general terms, it has lettered disks rotated by the blind writer so as to bring letter after letter in position to imprint upon a paper which moves along before the writer. It is simple but clumsy, far inferior to a type writer, which it would be easy to furnish with raised letters on its plungers: it is hardly worthy of the praise bestowed by "*La Nature.*" Shown in "*Scientific American*," * xxxvii. 210.

Dip'per. A form of dredging machine which has a large ladle on the end of a spar. This is plunged under water, scoops along the bottom, and then rises to the surfaee, and diseharges its load into a lighter.

The principle is showu in Fig. 1896, vol. i., "*Mech. Dict.*," though the machine there shown is not aquatic.

Dip'per Ear'-trum'pet. An aural instrument with a dipper or cup-shaped pavilion. The sound waves entering the flaring mouth are reflected by the parabolic bottom towards a commou center, and thence conducted by a tube to the ear.

Figs. 225, 226, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Dip'ping Wheel. (*Fishing.*) A contrivance used in Southern rivers to meet local demand for fish.

Fig. 826.

Dipping Wheel.

It is set in the stream so as to be turned by the current, and has a number of dip-nets which raise the fish and tumble them out at the axis in the manner of the scoop-wheel. The inclination of the nets is toward the catching-box at the side.

Dip'ping Vat. (*Ceramics.*) The trough containing fine glazing slip in which biscuit ware is dipped to be covered with the material which, baked on, forms glaze.

Dip Reg'u-la'tor. (*Gas.*) A device used in gas works for regulating the seal of the dip-pipes in the hydraulic main, and for drawing off the heavy tar from the bottom of the main without disturbing the seal. See Fig. 1660, p. 705, "*Mech. Dict.*"

Di-rect'-coup'led Steam En'gine. A form of engine in which the piston-rods of two engines are coupled directly to the same crank.

The term is held to include the form shown in Fig. 713, in which the crank is rotated by the intervention of a triangular connecting-rod.

Di-rect' Fire. 1. (*Fire-arms.*) That kind of action in which the plungers lie and strike the ignition in a line parallel with the axis of the barrel.

2. (*Glass.*) A glass furnace with no artificial draft other than derived from the chimney or stack.

Di-rect' I'ron Pro'cess. A process for procuring directly from the ore an iron which is practically pure chemically, although mechanically mixed with certain impurities. The Catalan, the most ancient of processes, employed to produce charcoal blooms.

The modern direct methods are discussed in a report by A. L. Holley, Group I., "*Centennial Reports*," vol iii., p. 40. Blair's and Siemens's processes are considered: —

"Blair's consists in deoxidizing the ores rapidly by gas and solid fuel, but without fusion, and then withdrawing the iron-sponge cold, without allowing it to oxidize again. The sponge is compressed and charged into the open-hearth furnace, or it is reheated or charged, or it is melted in a cupola and then treated in the open hearth. The best manner of using the sponge does not appear to be fully settled. Siemens's process consists in melting ore, together with coal and limestone enough to reduce it, in a rotating furnace, tapping off such slag as will run, squeezing the remaining slag out of the ball, and charging the ball hot into the open-hearth furnace. The radical trouble in all direct processes has been the waste of iron in getting it from the sponge into merchantable form. The addition of the open-hearth process greatly relieves this difficulty." — *Holley.*

See also Rotator; Sponge.

Di-rect'or. (*Surgical.*) A grooved instrument to serve as a guide to a knife, probe, scissors, bistoury, herniatome.

Exploring director	Fig. 135, p. 44, Part I.
Exploring director	Fig. 184, p. 61, Part I.
Allingham's anal scissors director	Fig. 589, p. 121, Part III.
Anal and rectal director	Fig. 591, p. 122, Part III.
Levis, hernia director	Fig. 629, p. 126, Part III.

Tiemann's "Armamentarium Chirurgicum."

Di-rect' Pro'cess. (*Metallurgy.*) One by which a metal is obtained in working condition by a single process from the ore. It is said of malleable iron obtained in loups for blooms by open-hearth process, in contradistinction to the double operation of obtaining pig iron by blast furnace and converting pig into malleable iron by puddling and hammering. See Direct Iron Process.

Dis-gorg'er. (*Fishing.*) An implement used in discharging a gorged hook from the mouth or stomach of a fish. It is pushed down along the line, pushes back the barbed point, and thus assists in retracting the hook.

Dis'in-fect'ing Stove. A stove with adjacent drying chamber provided with bars on which to hang the clothes while exposing them to a heat of 159° C.

In the Chemical Department of Public Health of Dresden the following is given as the relative value of the articles stated, as disinfectants, — chloride of lime and sulphuric acid being 100: —

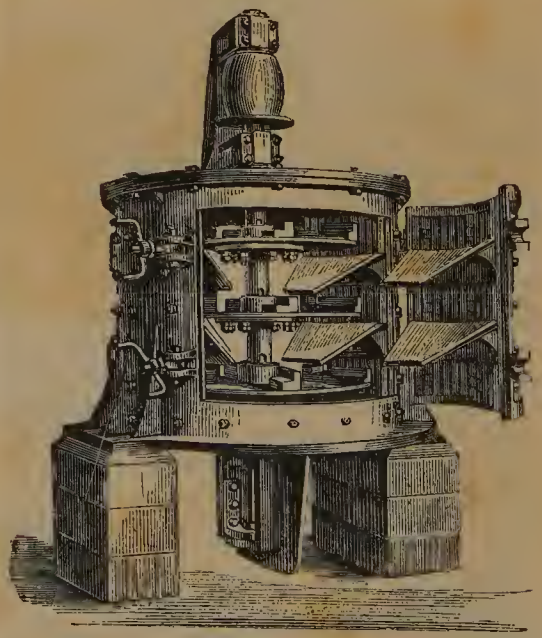
Chloride of lime, with sulphuric acid	100
Chloride of lime, with sulphate of iron	99
Luder and Liedloff's powder	92
Carbolic acid disinfecting powder	85.6
Slaked lime	84.6
Alum	80.4
Sulphate of iron	76.7
Chloralum	74.0
Sulphate of magnesia	57.1
Permanganate of potash, with sulphuric acid	51.3

Dis-in'te-gra'tor. A pulverizing machine operating by percussion.

The success of *Carr's* disintegrator, shown at Fig. 1665, p. 707, "*Mech. Dict.*," has been the incentive to the invention of a large class of machines which go by the name of disintegrators, the common feature of which consists in pulverizing by percussion, in the breaking by blows of rapidly revolving arms, spokes, or cages, as distinct from the grinding by attrition between surfaces.

The range of material to which the disintegrator has been

Fig. 828.



Vapart Disintegrator.

adapted has also been very much extended, and includes breaking and pulverizing —

Asphalt rock.	Grain of all kinds.
Bark.	Graphite.
Bones.	Guanos.
Cement.	Minerals.
Coal for patent fuel and coke making.	Mixing chemicals, clays, colors, fertilizers, sugars.
Coprolites.	Oil cake.
Fertilizers.	Ores.

The *Vapart* disintegrator consists of three horizontal platforms keyed to a vertical shaft. The platforms are fitted with vanes placed radially. The shaft is supported below by a footstep, and above by an ordinary bearing. The platforms are inclosed in a cast-iron cylindrical casing, fitted with two doors to give access to the interior. Between the platforms, and attached to the casing, hoppers are fixed to deliver the material to the center portion of the platforms, and opposite the platforms serrated segments of chilled cast iron or steel are attached.

The shaft and platforms are made to revolve rapidly, and the material is first delivered into the machine near the center of the first platform, where the velocity is low. It is then guided by the vane, and by centrifugal force is projected violently against the first series of segments. The broken material falls by its own weight down the first hopper to the center of the second platform, and is again thrown violently against the second series of segments, and afterwards against the third, when the material finally falls out of the machine in a thoroughly disintegrated state. Two arms fixed under the last platform serve to keep the machine clear. The pulverized material can then be led away on a belt or otherwise, as may be convenient.

Various forms of disintegrators are found in the columns of "*Engineering*," October 18, 1878; and proximate dates including: —

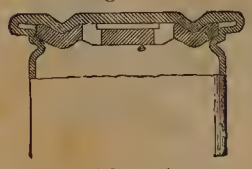
* *Carr's*,	* *Wilson's*,
* *Sherwin's*,	* *Vapart.*
* *Carter's*,	

The machines of *Hawksley* and of *Western & Co.*, of London, and *Bichou & Cie.*, of Paris, have been prominent at late expositions.

Carr	* "*Sc. Am. Sup.*," 2496.
	"*Com. Trade Jour.*," Br., June 8, 1878.
Carter . . .	* "*Engineering*," xxi. 135.
	* "*Sc. Am. Sup.*, 240.
Sherwin, Br. . .	* "*Engineer*," xlv. 354.
Vapart, Fr. . . .	* "*Engineering*," xxiii. 448.
	"*Iron Age*," xxii., Aug. 1, p. 1.
	* "*Scientific American*, xxxvii. 67.

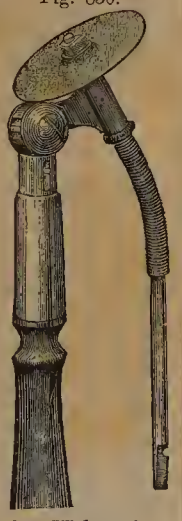
Disk An'vil. A strengthening plate or reinforce placed inside the head of a cartridge to support the impact of the striking pin which explodes the fulminate. See also CUP ANVIL.

Fig. 829.



Disk Anvil.

Fig. 830.



Dr. Hickman's Disk Carrier.

Disk Car'ri-er. (*Dentistry.*) A device for holding a cutting, grinding, or separating disk at the end of a handle while it is rotated by a flexible shaft driven by the dental engine. It is used in separating the teeth, cutting out lingual and buccal fissures, and finishing fillings and rough surfaces.

Disk Cut'ter. An instrument for cutting circles of thin glass for covers of microscopic objects on slides. A diamond is on the end of the arm, which is adjustable to suit the radius of glass cover required. See CIRCLE CUTTER.

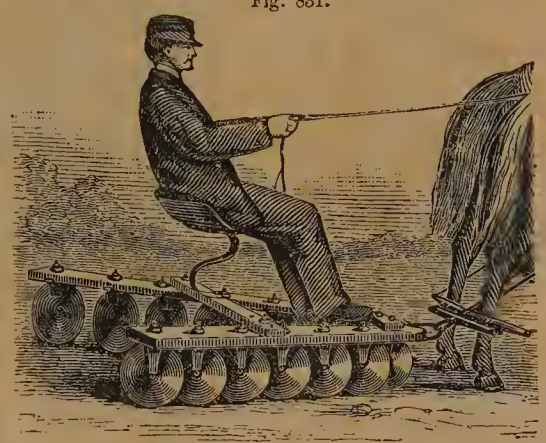
Disk E-lec'trode. (*Electricity.*) An electrode for telegraphic instruments in which the connection is secured by the contact of the peripheries of two disks, the axes of which are at right angles. The contact is a mere point or dot. The disks are of brass with platinum wires let into grooves on their peripheries, the densely-drawn hard wire permitting a fine and small contact. — *Cumming.* See TELEGRAPH KEY; also Fig. 847, p. 266, *infra.*

Disk En'gine. A form of steam engine invented by Dakeyne in 1830. Improved by Bishop, Ericsson, and others.

See *Bishop*, C, Fig. 1666, p. 708, "*Mech. Dict.*" (Wabbling).
Ericsson, A, B, same figure (revolving).
Taylor and Davis, 1836, 1838. (Br. patents.)
Gorsage, 1838.
Geiss, 1870.
See *Laboulaye's* "*Dictionnaire*," etc., tome iv., article "*Machines à Vapeur*," Figs. 3644-3646.
See also FOUR-CYLINDER ENGINE, SIX-CYLINDER ENGINE.

Disk Har'row. (*Agric.*) A harrow having a triangular frame, with a driver's seat mounted upon it, and carrying a number of sharp-edged and concave disks, set at such an angle in relation to the line of draft that in revolving they pulverize the soil, cutting, lifting, and turning it over in small furrows. A scraper is provided for each disk, so as to keep it constantly free from dirt.

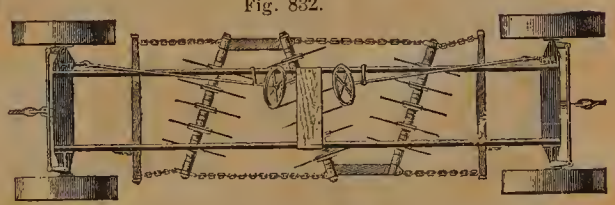
Fig. 831.



Nishwitz's Disk Harrow.

La Dow . .	* "*American Manuf.*," July 16, 1880, p. 13.

Fig. 832.



Fowler's Disking Machine.

Disk'ing Ma-chine'. (*Agric.*) A steam-cultivating implement to be drawn by an engine over sod or plowed sod, to renew the ground, or to prepare for seeding. Circular steel disks are presented obliquely to the line of draft so as not merely to cut into the ground but make a slight furrow.

Dis-place'ment Ap'pa-ra'tus. Guerin's continual displacement apparatus consists of a vertical series of vessels; at bottom a flask in a sand bath, a percolator, receiver, and condenser, vertically in the order stated. The vapor of the lower member condenses in the upper one, is received in the next below it, and thence flows intermittingly into the percolator, from whence it reaches the flask at bottom.

"*Scientific American*"	* xlii. 180.

Dis'lo-ca'tion Ap'pa-ra'tus. (*Surgical.*) This includes bandages, splints, apparatus for reducing, and for maintaining restored parts *in situ*, and for preventing recurrence.

The figures refer to *Tiemann's "Armamentarium Chirurgicum,"* Part IV.

Humerus	Figs. 55, 131.
Clavicle	Figs. 56, 150.
Hip	Figs. 87–89, 132, 133.
Knee	Figs. 93, 146.
Phalanges	Figs. 134–137.
Elbow	Fig. 148.
Radius and ulna	Fig. 151.

Dis-sect'ing Hook. A fine two-clawed hook used as a prehensor in making dissections.

Fig. 833.

Dissecting Hook.

Dis-sect'ing In'stru-ments. (*Surgical.*) The list embraces a variety of instruments, post-mortem and dissecting, the larger number of which may be found under their specific titles. See list under SURGICAL INSTRUMENTS, *infra* and *"Mech. Dict."*

Among them are the following: the figures refer to *Tiemann's "Armamentarium Chirurgicum,"* Part I.

Anatomical syringe	Fig. 313.
Cartilage knife	Fig. 314.
Dissecting hook	Figs. 315, 316.
Grappling hook	Fig. 318.
Chain hook	Figs. 317, 319.
Reamer	Fig. 320.
Rachitome	Fig. 321.
Costotome	Figs. 322, 323, 333.
Scalpel	Fig. 325.
Brain knife	Fig. 326.
Enterotome	Fig. 327.
Calvarian hook	Fig. 328.
Saws	Figs. 329, 332, 333.
Hammer and chisel	Figs. 330, 331.
Scissors	Fig. 151.

Dis-sect'ing Ta'ble. One with arrangements devised for the convenient presentation of the subject, the disposition of the disjecta, etc.

A table with arrangements for disposition of effluvia is shown in *Laboulaye's "Dictionnaire des Arts et Manufact.,"* Figs. 3630–3632, article *"Insalubres,"* tome iv., ed. 1877.

McIlroy's table, shown at the Philadelphia Exposition, 1876, is of convenient size and height, is supported on a stem connecting with a scale beam in the stand, affording the means of weighing the subject; it is dished to the center to collect the liquid of ablution or effusion; has means for the exhibition of disinfectants, etc.

Dis-sue'ing. (*Mining.*) Breaking away the rock from off the walls of a small and rich lode, in order that the ore may be moved without the accompanying worthless gangue.

Dis'tance Meas'ur-er. An angulometer, telemeter, etc. (which see): —

The instrument invented by Lieutenant Unge of the Swedish service is a stop watch to measure the interval between flash and sound. The pointer is placed at XII., and when the flash is observed a button is pressed, and the pointer begins to traverse. When the sound is heard the knob is released and the distance observed. The dial is divided into special peripheries according to the seasons.

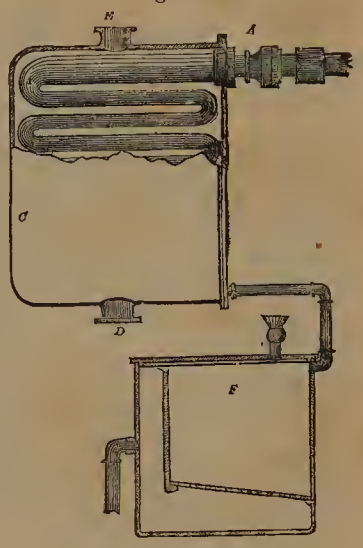
Distance indicator, *Watkin* . *"Scientific Amer.,"* xxxvi. 22.

See also TELEMETER, Figs. 6255, 6256, pp. 2513, 2514, *"Mech. Dict."*

Dis-til'ling Ap'pa-ra'tus. Baird's distilling apparatus for making potable water by condensation of steam from the boiler is used on board vessels of the United States Navy. Fig. 834.

It consists of an aërator, condenser, and filter. The aërator is at *A;* the steam passing towards the coil draws in air at a number of circumferential holes, and the air and steam pass together into the flat coil of copper twined inside. Sea water enters the condenser *C* at *D* and passes off at *E*. The water of condensation then passes by pipe to a filter, *F*, of purified granulated animal charcoal to deprive it of organic matter and oils which come over with the steam. See also STILL, *"Mech. Dict."*

Fig. 834.



Baird's Distilling Apparatus.

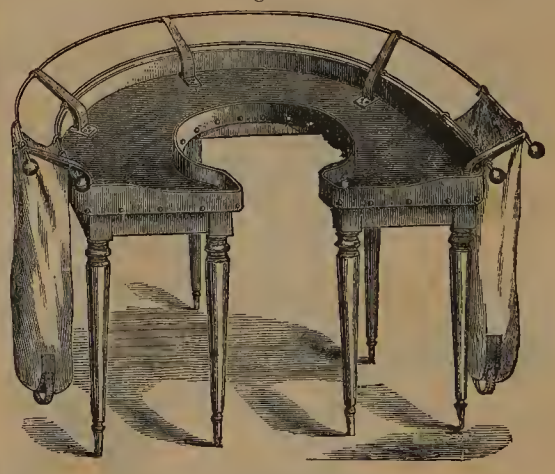
Dis-trib'u-ting Ta'ble. A table on which letters are collected and from which they are distributed into mail bags suspended around it in a horse-shoe form, the distributor standing in the middle. Fig. 835.

Ditch Clean'-er. A square-ended scoop set at an angle with the handle to reach the bottom of a ditch while standing on the surface of the ground.

Two kinds are shown: one to push and the other to pull. Fig. 836.

Ditch'ing Ma-chine'. A machine for digging or plowing ditches.

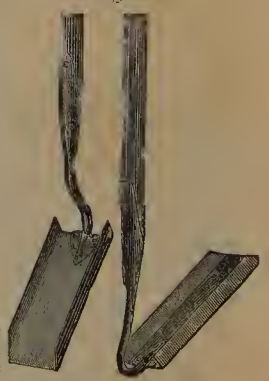
Fig. 835.



Distributing Table.

The ditching machine of Theodore F. Randolph is shown in Fig. 837.

Fig. 836.



Ditch Cleaners.

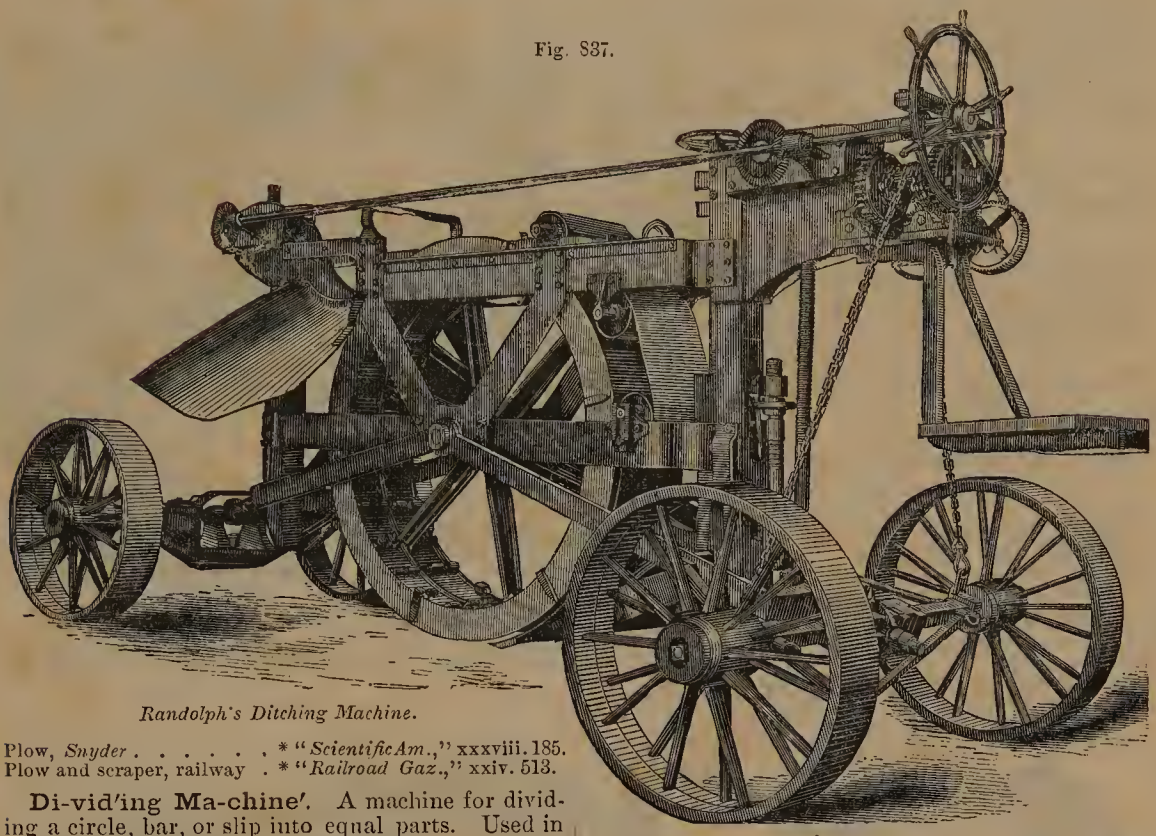
The digger share operates in the grooved periphery of a rotary flanged wheel, and has an adjusting attachment that regulates the depth of penetration. The flanged peripheries of the wheel penetrate and its rotation elevates the loosened soil, depositing it on the slide-way or apron that sheds it clear of the ditch on either side, optionally. A chisel-shaped cleaner attached to the slide-way works between the flanges of the wheel, cleansing it of its load, and guiding the dirt to the apron.

The large machine requires an eighteen horse-power engine to operate it; and it is calculated that it will dig eight cubic yards a minute in clay soil; equal to a man's work for a day, per minute.

The machine has adjustments for depth, and means for guiding under the control of the man who stands upon the platform. See also, —

Machine, *Gonellaz* . . . . * *"Scientific Amer.,"* xxxv. 159
Plow, locomotive, *Buchanan* * *"Engineering,"* xxx. 166.

Fig. 837.



Randolph's Ditching Machine.

Plow, *Snyder* . . . . . * "*Scientific Am.*," xxxviii. 185.
Plow and scraper, railway . * "*Railroad Gaz.*," xxiv. 513.

Di-vid'ing Ma-chine'. A machine for dividing a circle, bar, or slip into equal parts. Used in graduating rules, scales, etc. See

Mass. Institute Technology * "*Scientific Am.*," xxxv. 195.
Linear, Stevens Institute . * "*Scientific Am. Sup.*," 704.
P. Dumoulin-Froment . . Wolcott Gibbs' report, "*Vienna Exposition* (1873) *Reports*," vol. ii., § F, p. 6.
Perreaux . . . . . *Ibid*, p. 6.
P. Dumoulin-Froment . . Prof. Barnard's report, "*Paris Exposition Report*," 1867, vol. iii., p. 613.
Perreaux . . . . . *Ibid.*, p. 613.

Div'ing Ap'pa-ra'tus. Sub-aqueous appurtenances and machinery for the protection and assistance of divers. See

Signaling apparatus.
Protheroe, Br. . . . . * "*Engineering*," xxiv. 127.
* "*Scientific Am. Sup.*," 1478.
Diving apparatus, *Richardson* * "*Scientific Am. Sup.*," 3848.
Improvised apparatus, Magdalena River . . . * "*Scientific Am. Sup.*," 1952.

Bell, article "*Plongeur*," *Laboulaye's* "*Dict. des Arts et Manufactures*," iv., ed. 1877; describing apparatus of: —

Smeaton. *Cavé.*
Rennie. *Hallett & Williamson.**
Coulomb.

Dress, article "*Plongeur*," section "*Scaphandres*," *Ibid*, iv., ed. 1877; describing apparatus of: —

Leonardo da Vinci. *Rouquayrol-Denayrouze.**
Dean & Siebe. *Heinke.*
Bridge of Tarascon.

See also Figs. 4272, p. 1923; 6025, 6026, p. 2437, "*Mech. Dict.*"; Figs. 359-361, pp. 155-157, *Ibid.*

Di-vis'ion Cath'e-ter. (*Surgical.*) A double current catheter, allowing liquid to be injected and withdrawn by distinct ducts in the same instrument and simultaneously.

Fig. 1190 *e*, p. 504, "*Mech. Dict.*"

Di-vis'ion Reg'u-la'tor. (*Electricity.*) A regulator adapted to allow several or many lights on one circuit. Usually called a *polyphote* or many-light regulator.

They are of three kinds: —

Differential.
Derivation.
Fixed interval (Regulators *à écart fixe*). See POLYPHOTE REGULATOR, and the above.

Di-vul'sor. (*Surgical.*) An instrument to rend asunder the walls of a constricted passage. The urethral divulsor for obliterating strictures is the most notable instance. See STRICTURE DILATORS, Fig. 5995, "*Mech. Dict.*"

The term *dilator* in one sense includes *divulsors* and in another direction *speculi*; the latter use being to expose, while in the former case it is to expand.

Thompson's, *Gouley's*, and *Hott's* stricture divulsors are shown at Figs. 64, 67, 66, Part III., *Tiemann's* "*Armamentarium Chirurgicum*," in company with other instruments called *dilators*, but the use of which is practically the same.

Anal divulsors and *dilators* on p. 119, Part III., *Ibid.*

Dob'by Ma-chine'. (*Weaving.*) A loom for weaving fantastic patterns; such a loom for instance may contain from 12 to 30 blades. The mechanical principle is similar to that of the Jacquard, of which it might be termed a simplification. In the dobby machine the pattern is obtained by means of little pegs, which according to the requirements are placed in the holes of the bars of a lath work. The bars correspond to the cards of the Jacquard.

Ainsworth's . . * "*Scientific American Supplement*," 3896.

Dock. (*Hydraulic Engineering.*) *a.* (*Wet.*) A basin to contain vessels for loading or discharge.

b. (*Dry.*) An excavation into which a vessel is admitted, inclosed, and exposed by pumping out the water contained in the dock. A *graving* dock, Fig. 2308, "*Mech. Dict.*"

c. A caisson which is sunk in position beneath a vessel and then floated therewith by pumping out the water contained in the caisson, Plate XIX., p. 884, "*Mech. Dict.*"

d. A depositing dock, which raises a vessel by means of sunken and subsequently floated caissons or camels and then shifts it to a staging which it may occupy for any required time, while the float-

ing apparatus repeats the process on other vessels. See DEPOSITING DOCK, *supra*.

See the following references: —

Air cushion for dry dock	* "*Sc. Amer. Sup.*," 1328.
Avonmouth, Bristol, Engl.	"*Van Nostr. Mag.*," xx. 179.
	* "*Sc. Amer. Sup.*," 1124.
Ayr, Scotland	* "*Engineering*," xxvii. 196, 242.
Bombay "Princes"	* "*Engineering*," xxiv. 266.
Clyde, (New)	"*Iron Age*," xxi., May 9, p. 5.
Dry Docks	"*Sc. Amer. Sup.*," 2070.
Holyhead	* "*Engineer*," l. 86.
Liverpool	* "*Sc. Amer.*," xxxvii. 150.
Nicolaieff, Russia	* "*Engineer*," xlvi. 64, 75.
	* "*Sc. Amer. Sup*," 399, 661.
Philadelphia, *Crump*	"*Iron Age*," xvii., May 25, p. 15.
Portable dock-engine, *Mundy*	* "*Iron Age*," xix., May 10, 1; xviii. Sept. 21, 9.
Thames, "Victoria Extension"	* "*Engineer*," xliv. 20; xlix. 457; l. 10.
	* "*Engineering*," xxv. 246
	* "*Sc. Amer. Sup.*," 1956.
Tubular	"*Man. & B.*," xviii. 180.
Woolwich, "Royal Albert"	* "*Sc. Amer. Sup.*," 3338.

Consult: "*The Dockyards, Shipyards, and Marine of France.*" *P. Barry.* London, 1869.

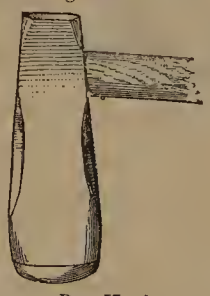
"*The Naval Dry Docks of the United States. Charles B. Stuart.* Illustrated with 24 fine steel engravings. New York, 1870.

Dock Block. A tackle-block secured on a dock or wharf to change the direction of a rope passing to a cargo-lifting tackle. It has a universal ball-and-socket joint, to permit the block to swing in any direction.

Fig. 838.

Dock Block.

Fig. 839.



Dog Head.

Dog'-Head. A hammer used by saw makers in stretching the blade, that is, in removing a tension. The weight is about 3 pounds and the length 5½″. The handle, 14″ long, stands at an angle of 85° with the body of the hammer. Its face is rounding and of an even sweep. Fig. 839.

Do-mes'tic Mo'tor. One adapted for household use, to run sewing or knitting-machines, pump water, etc.

Many small forms of *steam engines* have been specially invented and offered for this purpose. *Gas*, *hot-air*, and *caloric engines* are specially well adapted. *Hydraulic motors*, operated by water from the mains, have an aptitude for this use. Also *spring* and *electro-magnetic* motors.

See under the various heads. Also p. 2123, "*Mech. Dict.*," and list of 72 patents of SEWING-MACHINE MOTORS, on p. 2115, *Ibid.*

See also —

"*Revue Scientifique*"	"*Van Nostrand's Mag.*," xxiii. 6.
Tyson	* "*Eng. & Min. Jour.*," xxvi. 365.
Ericsson	"*Eng. & Min. Jour.*," xxx. 91.
Domestic steam-engine.	
Landis	* "*Scientific American*," xxxvi. 22.

Dome'-top In'stru-ment. (*Surgical.*) Said of hollow instruments of introduction, such as a speculum or trocar, which has a rounded end.

Don'key Pump. A supplementary steam-pump, for use when the major engine is not in operation; or for specific purposes at any time; fire, bilge-water, washing decks, etc.

Bastin, Br.	* "*Engineer*," xliii. 328.
Gillett, Br.	* "*Engineer*," xliv. 50.
Leupold, Br.	* "*Engineer*," xliii. 441.
	* "*Sc. American*," xxxvii. 82.
Sulzer, Switz.	* "*Engineering*," xxvi. 162.

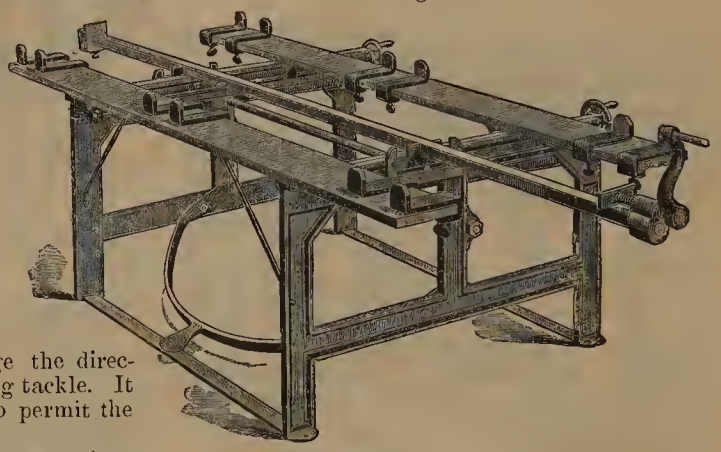
Door. See various references to doors and adjuncts, as follows: —

Door bolt, *Hoesly*	* "*Scientific American*," xl. 198.
Double, *Brachmann*	* "*Scientific Amer.*," xliii. 310.
Door-check, *Collins*	* "*Scientific Amer.*," xxxiv. 355.
Perkins	* "*Scientific Amer.*," xl. 131.
Door for fastening barn	* "*Scientific Amer.*," xxxiv. 402.
Double-handle. Lock-nut.	
Harland, Br.	* "*Engineer*," xliv. 395.
Door-knob, Whipple	* "*Scientific Amer.*," xxxv. 153.
Door-knob screws	* "*Scientific Amer.*," xxxvi. 275.
Door-spring, concealed.	
Barker	"*Iron Age*," xix., May 17, p. 18.
Door-spring, Torsion rod.	
Gray	"*Iron Age*," xxi., May 2, p. 42.

Door Clamp. (*Carpentry.*) A bench and frame on which the various parts of a door are assembled and then pushed together and held by clamps.

The bench shown in Fig. 840 is adapted for door, sash, or blind work; the action of the longitudinal clamp, and the two transverse clamps is evident. The pressure is given on each end of the tenon of each rail, the side-pressure being given by treadle while the end-pressure is given by hand.

Fig. 840.

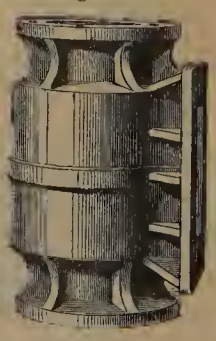


Door, Sash, and Blind Clamp.

Door Piece. The valve chamber of the stock of a Cornish pump-lift. A section containing a door or cover, which may be removed to admit examination of the valve and seal, or removal for repairs.

See Fig 1467, page 626, "*Mech. Dict.*"

Fig. 841.



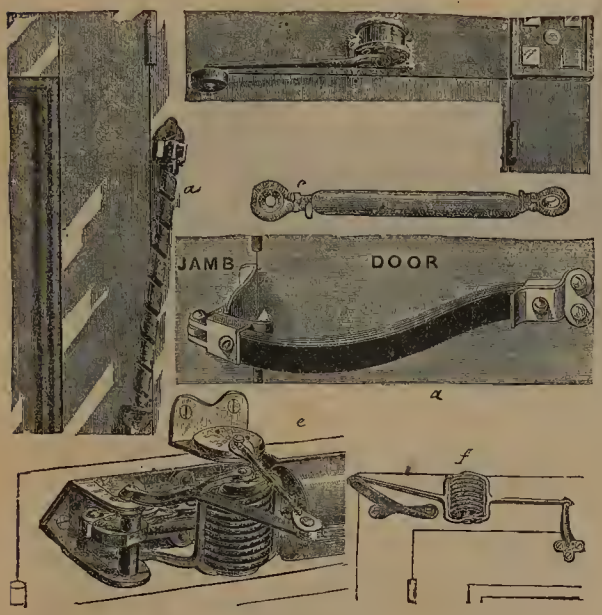
Door Piece.

Door Rel'ish-ing Machine'. (*Carpentry.*) A machine for trimming a tenon. See SASH RELISHING MACHINE.

Door Spring. An attachment to a door to close it. In some cases the spring operates to keep it open after it has passed 90° of rotation on its hinges. See BUTT HINGE. One form of door-spring is shown at Fig. 1688, p. 721, "*Mech. Dict.*"

Six other forms are shown in Fig. 842, pneumatic, spiral, and caoutchouc, arranged in various forms.

Fig. 842.



Door Spring.

a. "Boss" door-spring.
b. Sabin's lever door-spring, with a maximum when the door is closed.
c. "A. B. C.," india-rubber door-spring. *d.* 'Centennial."
e. Geer's air-cushion door-spring; the greatest pressure at the point of closure.
f. "Hercules" door-spring; the same action as the previous one, but not pneumatic.

Dor'mant Scales. Warehouse scales, the platform of which is let in even with the floor, so as to roll a truck upon them.

Do'ry. (*Fishing.*) A small flat-bottomed fishing boat.

Do-sim'e-ter. An instrument for measuring prescribed quantities. The term is frequently applied to a drop-meter such as that of Prof. Thurston, which consists of a steel wire tapered to a point and affording a means of obtaining small drops of equal quantity.

Fig. 843.

Colmar's Dosimeter.

The dosimeter, Fig. 843, is a glass tube with a taper end and graduated to indicate drops, minims, and other measures according to the requirements of any given purpose or capacity. In the top is fixed a syringe with a rod which has an adjustable stop to limit the stroke of the piston to any required extent. By this means any desired quantity may be drawn into the syringe and the traverse of the piston is watched to observe the quantity ejected if it be less than the whole.

See BURETTE, PIPETTE, DROP METER.

Dou'ble Act'ing Pump. One which is effective at each stroke, to and fro. See references: —

Amos & Smith, Br. * "*Engineering*," xxx. 462.
Carr . . . . * "*Manuf. & Builder*," xii. 148.

Dou'ble Bass. (*Music.*) A stringed musical instrument, the largest of its class.

It has three strings tuned in 5ths, or four strings tuned in 4ths. The compass is two octaves and a quarter. To this instrument belong the lowest sounds in the harmony.

Dou'ble Bas-soon'. (*Music.*) A wind musical instrument of lowest pitch in its class.

A double reed instrument which bears the same relation to the bassoon that the double-bass does to the violoncello.

Dou'ble Beam Bal'ance. One with two beams graduated in two systems; the *postal* balance, for instances, in grams and ounces: the *creamery* or *dairy* balance for weighing successive portions of cream or milk at a single draft; the *furnace* scale for weighing respective portions of ore, limestone, and coke at a single draft. See under the above heads.

Dou'ble Bell Pipe. One with a cup-shaped enlargement at each end to receive the ends of those in line with it. See *h* in BEND.

Dou'ble Blast Forge. One with two tuyères acting upon the same bed of coals. *Enfer*, Paris.

Dou'ble Bo'gie. One with a bogie at each end. A DOUBLE ENDER. See BACK TRUCK LOCOMOTIVE, Fig. 168, *supra*.

Car, Midland Railway, Br. * "*Engineering*," xxi. 533.
Locomotive, *Fairlee*. * "*Scientific American Sup.*," 72.
* *Anderson's* report, "*Paris Exposition* (1878) *Reports*," vol. iv., p. 452.

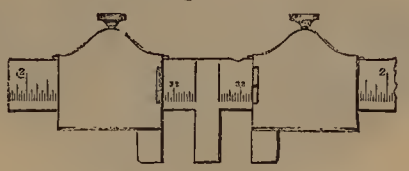
Dou'ble Bor'ing Ma-chine'. A machine with two augers, bits, drills, as the case may be.

Boring and facing, *Bede et Cie.*, Fr. . * "*Engineer*," xli. 5.

See also DOUBLE-TRAVERSE DRILL, *infra*; MULTIPLE DRILL, etc.

Dou'ble Cal'i-pers. Two calipers upon the same bar graduated respectively on each side of the central zero abutment.

Fig 844.



Double Calipers.

Useful for making two separate measurements of an object, as the width and thickness of a quadrilateral steel bar.

Dou'ble Car'-axle Lathe. A lathe in which the axle is passed through the center-head and turns on dead centers at the respective ends. Each end of the axle is operated upon at the same time and finished without turning end for end. An equalizing driver attached to the side of the driving wheel distributes the driving force uniformly through the whole axle, overcoming the tendency to lateral strain. Changes of feed for roughing and finishing without changing wheels. Fig. 845.

Dou'ble Coil Gal'va-nom'e-ter. A refinement of the astatic galvanometer, invented by Sir William Thomson. It has two coils, one above the other, exactly alike in their effect upon the compass-needle, situated in the middle of each. A bar magnet above serves to give direction to the needles and may be moved up and down so as to nearly neutralize terrestial magnetism if desired. The connections at the base serve to keep the coils in combination, either as acting together or counteracting one another. Used in submarine telegraphing.

"*Manufacturer and Builder*" . . . . . * xi. 276.

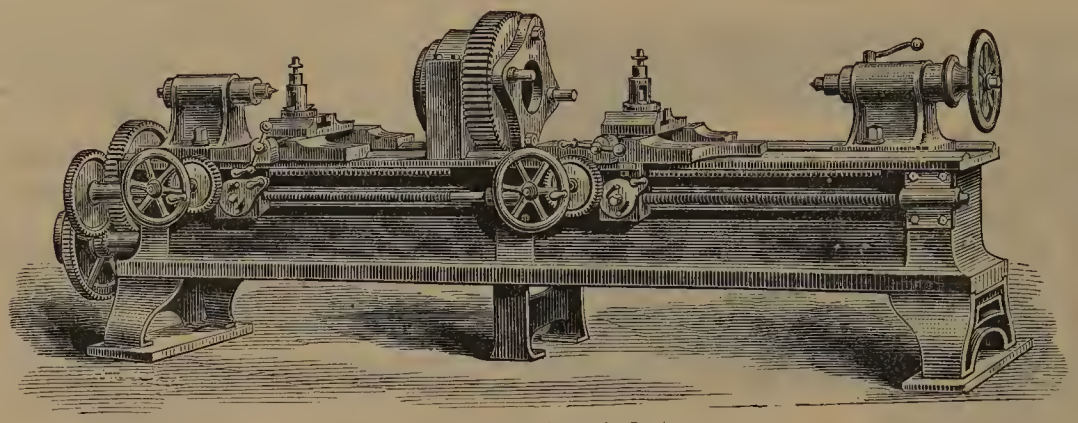
Dou'ble-cone Lamp. A lamp the glass of which consists of a cylindrical equatorial zone, and conico-frustal zones above and below.

Dou'ble-cone Re-flect'or. A form of ventilating reflector for the ceilings of auditoriums. Made in various sizes, diameter 25″ and upward, with from 6 to 150 burners. Fig. 846.

Dou'ble Con-nect'er. (*Electricity.*) A connecter with two binding screws for as many wires.

Dou'ble Cur'rent Cath'e-ter. (*Surgical.*) A catheter with two tubes or a divisional tube, so

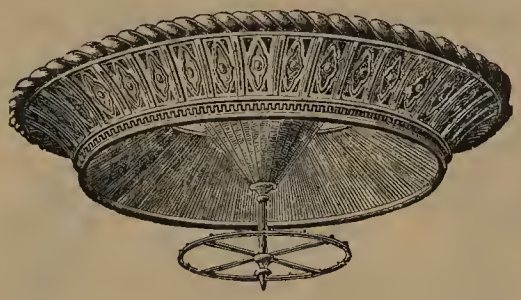
Fig. 845.



Niles' Double Car-axle Lathe.

as to permit a current to be injected into the bladder through one duct, while the washing of the bladder passes out through the other duct. See *c*,

Fig. 846.

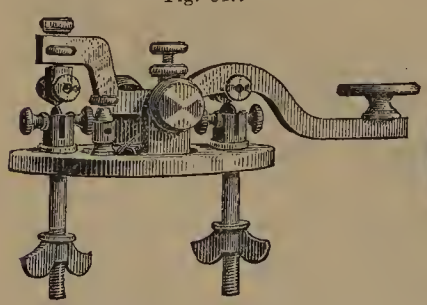


Double-cone Reflector.

Fig. 1190, p. 504, "*Mech. Dict.*" Also known as a *Division Catheter*. See also DEBRIS EVACUATOR.

Dou'ble Cur'rent Key. (*Electricity.*) A telegraph key with points or contacts at each end, the two legs being insulated and a third (middle) contact being connected with the base. For data see DISK ELECTRODE.

Fig. 847.



Cumming's Double Current Key.

Of the two points with which the ends of the key connect, one leads to a battery with its positive pole to the line and the other to the corresponding negative pole. The right hand of the key (as shown) being depressed, makes a contact with the point below, and the current passes (say from the positive of the battery) through these contacting points, the trunnions of the key and to the base. When the lever is raised, the reversed current from the negative of the battery flows through the other arm of the key to line by the middle connection.

The three points on the base are insulated from each other and are connected only by the depressing and raising of the key lever. The special device shown is that of Cumming, which has contacting disks for contact, the disks being on axes at right angles to each other and having fine platinum wire inserted in grooves on the peripheries.

Risch . . . . . * "*Telegraph Journal*," vii. 93.

Dou'ble Cut Saw. A mill saw having one half the teeth turned towards one end of the saw and the other half the other way, each way from the center. Intended to cut equally up and down and discharge the saw-dust on top and bottom. The latter, of course, is not an object but an incident. — *Davis.*

Dou'ble Cut'ting-off Ma-chine'. 1. A two-headed lathe for railway axles and shafts up to 8″ diameter. Tool slides work at either end simultaneously, feeding together or separately.

2. A double cut-off saw, used by box-makers to square off both ends of dimension stuff at the same time.

Dou'ble Deck'er. Said of two-story or two-tier arrangements.

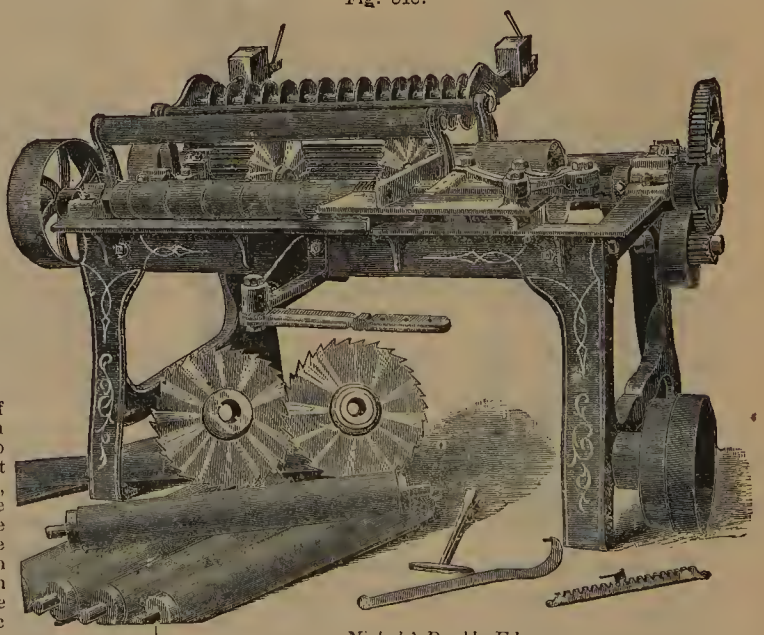
a. A ship with two decks above the water-line.

b. A railway car or street car with seats on the roof. Common in Europe.

c. A hog or sheep car with two decks.

d. A steam-boiler furnace with two tiers of firing chambers.

Fig. 848.



Nichols' Double Edger.

Dou'ble Door. *a.* A door in two portions, upper and lower, swinging or sliding independently :

used in express and mail cars. A pair of half doors in fact.

b. A pair of doors swinging or sliding, mutually approaching or receding, to close or open the doorway.

Dou'ble Edg'ing Ma-chine'. 1. (*Wood Working.*) A machine having a pair of circular rip saws at a regulatable distance apart, to dress both edges of a board at once.

The Nichols' double edger is particularly designed for edging boards in saw-mills, and sawing plank and boards from the mill into joists, scantling, flooring, battens, shingle-lath, etc. Fig. 848.

It has a feed roll in front, composed of small saws and collars alternately, and has a fluted roll behind the saws, over which is a weighted flanged press-roll, which serves to keep the board straight. For edging, one saw is made stationary and the other saw adjusted to any width. For ripping, an adjustable gage is provided with a lever running to the operator and a screw on the front feed-roll, which keeps the stuff to the gage.

"*Iron Age*" . . . . . * xx., November 22, p. 1.

2. (*Sheet Metal Working.*) A machine for folding the edges of blanks for pieced tin-ware preparatory to seaming. It is arranged to fold the parallel edges of rectangular blanks to form cans from 6″ to 22″ in length.

Dou'ble End'er. 1. (*Wood Working.*) A cross-cut sawing machine, which has a pair of circular saws at a regulatable distance apart to cut off both ends of a board at once.

Staves are brought to a length in a similar manner by sawing both ends.

The box-board double cut-off saw machine of *Richardson, Merriam, & Co.* is for equalizing stuff, squaring off both ends of box stuff at the same time. It has a frame with a light sliding carriage on which the stuff is fed to the pair of circular saws which are upon the same arbor but regulatable as to distance apart.

2. A file with two points, either end capable of being placed in the handle.

3. (*Nautical.*) A ship capable of moving in either direction, having bow and rudder at each end. A frequent form in ferry-boats.

On double-ender ships . . . . . "*Engineer*," xli. 431.

4. (*Railway.*) A locomotive with pilot at each end. A switching locomotive. See BACK-TRUCK LOCOMOTIVE, Fig. 168, p. 65, *supra.*

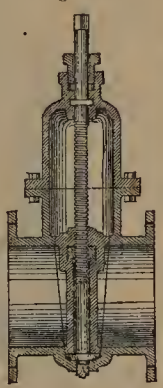
Anderson's report, "*Paris Exposition*, 1878, *Rep.*," * iv. 452.
"*Scientific American Sup.*," . *72.

Dou'ble-faced Ham'mer. 1. An engineer's hammer, with two flat faces; as distinguished from the hammer with one face and one *peen.* The latter may be square, cross, or pointed.

2. The stonemason's double-faced hammer has two square faces; is a heavy tool, weighing from 20 to 30 pounds, and is used in the quarry in the roughest work.

Dou'ble-face Mil'ling Ma-chine'. A machine tool suitable for milling pieces that have pivots on opposite sides, such as main-spring stirrups or swivels for guns. A geared shaft, with cone pulley of three grades, drives a face-plate which revolves the piece to be finished. The feed is accomplished by means of rack, pinion, and levers, which move the foot-stock spindle, carrying one mill against the revolving piece, and press the piece against a mill held in the head-stock. — *Pratt & Whitney.*

Fig. 849.



Double-face Valve. (*Section.*)

Dou'ble-face Valve. One coming fairly against a seat on each side of it. The valve jams between two faces, an element of security and support.

Dou'ble Fire'-cock. One having two connections, by Y-branch, for two hose, operated by a single screw valve.

Dou'ble Fluid Bat'te-ry. (*Electricity.*) One having the elements in different fluids to secure depolarization. A *constant* battery, which see.

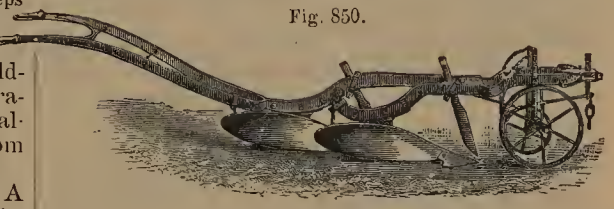
Becquerel's oxygen jar battery was the first to use two liquids, or a porous cell, and was the first constant battery. See BECQUEREL BATTERY.

Dou'ble Fur'nace Boil'er. One having two firing chambers, either double-tier, parallel, or at opposite ends.

Rowan, Br. . . . . * "*Engineer*," xliv. 413.
Saltaire Mills, Br. . . . . * "*Engineer*," xli. 274.

Dou'ble-fur'row Plow. (*Agric.*) One for plowing two furrows at once. A GANG PLOW; the invention of Lord Somerville, the latter portion of the last century, but much improved of late. The original form was of two plows locked in parallel position. That form is scarcely found now, except an implement made at Nancy, France.

Fig. 850.



British Double-furrow Plow.

Dou'ble-gate Valve. A valve for gas or water mains, having on each side a face which fits against its own seat. — *Isbell.*

See DOUBLE-FACE VALVE.

Dou'bled Glass. (*Glass.*) A glass made of several colors superposed. See FLASHED GLASS.

"It is worked in a different manner from plain glass. Colored glass when first made is generally drawn into sticks of a certain length and annealed. Suppose we now wish to blow an article made of white glass with a thin sheet of outside colored glass. A stick of colored glass is taken and heated gradually; the workman now takes up this stick on the end of his ponty and heats the glass in the glory-hole. When this is sufficiently plastic a quantity is cut off and attached to a blow-pipe also having a small lump of hot glass at its end. The colored lump is now heated again and blown in the usual way into a hollow ball. This ball is opened and formed into the shape of a cup. In the mean time another workman has gathered and blown another sphere of white glass of a suitable size. This sphere is now put into the cup-shaped colored glass, blown, and rubbed together while hot so as to make them adhere. We now have a ball of white glass inside and colored glass outside. This may be finished to any shape desired, in the usual way, with molds or tools." — *Colné.*

Dou'ble Har-poon' Fork. A hay-elevating fork having two harpoons forming a ∩-shaped implement with barbs on the points. A duplication of the harpoon fork, Fig. 2409, p. 1065, "*Mech. Dict.*"

Dou'ble Hook. (*Surgical.*) *a.* A tenaculum with two claws.

b. A two-clawed hook for fixing the eye during operation. *Double tenaculum*, Fig. 79, Part II., *Tiemann's "Armamentarium Chirurgicum."*

c. A prehensile two-armed instrument with two claws on each arm to grasp the eye in operation for extirpation. Fig. 78, *Ibid.*

d. See, also, Extirpation and Fixation Forceps, *Ibid.*, p. 25, Part II.

Dou'ble Im'age Prism. (*Optics.*) A prism of Iceland spar giving a double image of the object of complementary tints, and also used by revolving the images to measure the angle of crystals examined under the microscope.

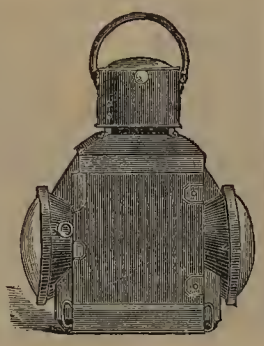
Dou'ble-jaw Vise. A vise having two pairs of jaws, either of which may be brought into play.

See ADJUSTABLE VISE, p. 5.

* "*Engineer*" . . . . . xlii. 182.

Dou'ble-lens Lan'tern. One having a lens on opposite sides to throw rays in opposite directions. Used as a tail side-light for trains, throwing light forward and aft.

Fig. 851.



Double-lens Lantern.

Dou'ble-lip Safe'ty Valve. One with two circular concentric avenues of egress for the steam as the valve rises.

Dou'ble-nose Piece. (*Optics.*) A means for using two object-glasses without unscrewing, whereby either is brought into the optic axis of the instrument.

Dou'ble Pis'ton Bal'anced En'gine. A form of engine in which two pistons of equal area reciprocate in a cylinder, mutually advancing and retreating. See next article.

Dou'ble Pis'ton En'gine. One having a pair of pistons mutually advancing and retreating in the same cylinder, each traversing half the length of the cylinder, the steam being alternately admitted between the pistons, to force them apart; and at their ends to force them together. — *Wells.*

"*Manufacturer and Builder.*" . . . . . * xi. 49.

See also BALANCED ENGINE.

Dou'ble Pit'man Press. A heavy stamping press for sheet-metal work, the slide being operated by two pitmans having eccentric connection with the same shaft. A measure of strength and steadiness.

Dou'ble Plan'ing Ma-chine'. (*Metal Working.*) A large planing machine having two pairs of independent heads on opposite cross-slides movable to any position on the bed. The two slides swivel to any angle and have variable automatic feed in all directions. The movement of the table is by screw and gearing driven by two belts separately shifted.

Dou'ble Plate Wheel. (*Railway.*) A car wheel which has two plates connecting the hub and the rim. The plates are generally corrugated in cast car-wheels, but are flat in the compound wheels.

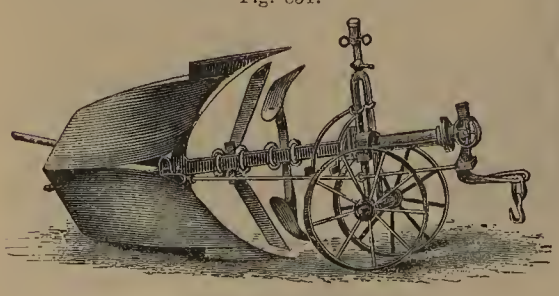
The Washburn wheel has a double corrugated plate next to the hub, about half way to the rim, and a single corrugated plate beyond it. *a a'* Fig. 1170, p. 493, "*Mech. Dict.*"

Dou'ble Plow. (*Agric.*) *a. A double furrow* plow, or one turning two furrows. See GANG PLOW.

b. A plow adjustable to turn a furrow to the right or to the left. A *side-hill* plow; a *turning mold-board* or *reversible* plow. There are four forms of this implement; see under the various heads.

The illustration is the Brabant double plow, which is perhaps the prime favorite in France at the present time. It has the skim share or jointer, and to reverse the plow and throw the furrow to the left, it is unlocked at the rear and revolved 180°.

Fig. 854.



Brabant Double Plow.

Double plows, French and American, Knight's report, "*Paris Exposition* (1878) *Report*," * vol. v.

See also "*Scientific American*" * xxxix. 163.

Dou'ble Pur'chase. (*Nautical.*) A form of tackle also known as *gun-tackle purchase* with two single-sheave blocks. *c*, Fig. 6159, "*Mech. Dict.*"

The *reef tackle* is also a double purchase.

Dou'ble Rach'i-tome. (*Surgical.*) An instrument with two parallel saws for making an excision of the spine.

Fig. 333, Part I., *Tiemann's* "*Armam. Chirurgicum.*"

Dou'ble Rud'der. A pair of rudders. Very common on our Western rivers, and on ferry-boats there and elsewhere, but not so much so on sea-going vessels. Twin screws and twin rudders are however, becoming more common in some classes of war vessels.

And movable propeller, *Sadler* . "*Sc. Amer. Sup.*," 1922.

Dou'ble Safe'ty Valve. A pair of safety valves on the same steam-pipe or dome. A measure of safety in case of one becoming rusted fast, or otherwise inoperative. Fig. 853.

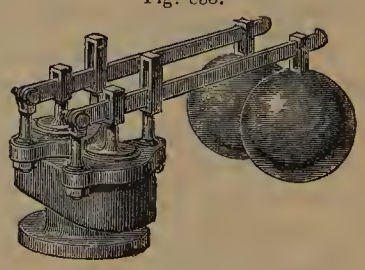
Dou'ble Screw. Said of a vessel with two screw-propellers.

Tug-boat, *Howden*, Br. . * "*Engineering*," xxi. 253.
"*Scientific American Sup.*," 363.

See also TWIN SCREW.

Dou'ble Screw Up'right Vise. A parallel-leg vise. A screw above and one below being operatable by the same handle maintain a perfect parallelism of the jaw faces.

Fig. 853.



Double Safety Valve.

The upper screw is connected by chain to the lower one so as to make their motion simultaneous and equal.

Dou'ble Shap'ing Ma-chine'. A shaper, the heads in duplicate, so as to act upon two portions of an object dogged to a common table.

Wood, *Robinson*, Br. . . . . * "*Engineer*," xlv. 276.

Dou'ble-shear Steel. (*Metallurgy.*) Blister steel, heated, rolled, and tilted to improve the quality, and the process repeated.

Dou'ble Steam-ket'tle. One kettle within another, the joint steam-tight, and steam occupying the interval.

Dou'ble Sur'fa-cing Ma-chine'. A wood-planing machine which acts upon the upper and lower surfaces of the board simultaneously.

Dou'ble Ten-ac'u-lum. (*Surgical.*) An instrument with two claws apposed by pivoting, in the manner of scissors.

Figs. 454, 461, 462, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

The double-claw tenaculum, Fig. 21, Part I., *Ibid.*

Dou'ble Trans-mis'sion Tel'e-graph. (*Electricity.*) A form of duplex telegraph.

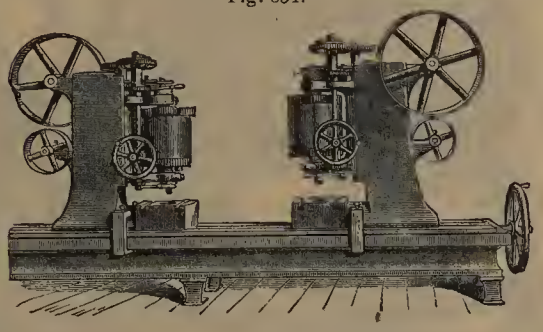
Sieur . . . . . * "*Telegraphic Journal*," vi. 375.

Dou'ble-trav'erse Drill. A machine-tool for boring holes simultaneously, at both ends of a bridge-link, for instance, to insure exactness where

many pieces of precisely the same size and proportions are required. The double-traverse drill has right and left-hand boring machines, sliding on a solid bed, and adjustable to or from each other to suit the required length of links.

The boring machines are so placed as to permit the links to be put in place from one side, and, when done, passed out

Fig. 854.



Sellers' Double Traverse Drill.

on the other side of the machine. The driving is effected by horizontal belts passing over guide pulleys, and around a drum on the spindles. The cutters are kept cool by water fed to them through the center of the spindle. The two heads are united by bars of wrought-iron, and can slide freely on the cast-iron bed. The expansion of the wrought-iron bars being the same as the expansion of the link being bored, insures uniformity in the length of the finished work.

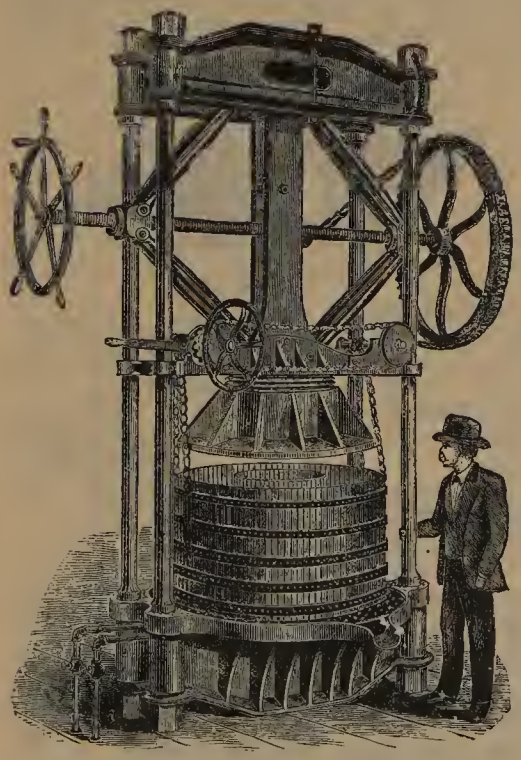
Dou'ble-truck Lo-co-mo'tive. (*Railway.*) A form of locomotive in which a leading pony truck is added to the driving. See instance in "*Railroad Gazette*," * vol. xxiv., p. 8, and full-page plate; a locomotive of the Denver, South Park, and Pacific Railroad. The pony truck in this case is to carry the overhanging weight of the cylinder and to protect the front driving-wheels from wear.

Dou'ble-tub Press. A cider or wine press which has two concentric cylinders, the pomace or marc occupying the space between the two, the piston or follower of the press being annular. A French press is shown in Dr. Knight's report, "*Paris Exposition* (1878) *Reports*," * vol. v., p. 232. The double tub gives two surfaces at which the liquid may exude, and the arrangement is very effective, inasmuch as it is especially difficult to drain the interior of the mass of pomace.

In the instance shown the power is applied by means of a toggle which is particularly suitable, the force increasing as the knees become more and more extended. To put the press in action the platen is depressed by means of a small hand-wheel placed at the end of the screw. When the pressure thus obtained is not sufficient, a stronger force may be obtained by the lever and ratchet-wheel.

See also Fig. 618, p. 196, *supra*.

Fig. 855.



Double-tub Press. (*Boomer & Boshert.*)

Dou'ble Tur'bine. *a.* A pair of turbine wheels on the same shaft, one receiving the water from the other. A doubtful expedient.

b. A pair of turbines on the same shaft, receiving the water between them and each discharging outwardly. A *double-head wheel.*

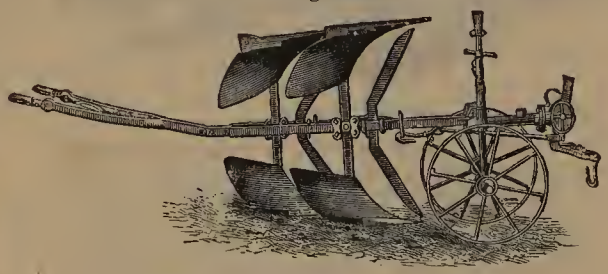
c. A turbine with a partition in the middle of the tier of buckets, dividing the wheel. More curious than useful, and the name a misnomer.

d. A combination of two kinds of turbine on the same shaft, — one a *vertical* and the other a *central* discharge. Leffel. Each receives its water from the same set of guides at the same time, half the water passing to each wheel. This is believed to afford a freer escape for a large volume of water than if the same area of opening were employed in a single wheel on either the vertical or central system of discharge.

Dou'ble Turn'ing-mold'-board Plow. (*Agric.*) A double-furrow plow, having the additional capacity for turning the furrows either to the right or to the left. A gang-plow adapted for hill-side work.

The instance shown is the *Brabant double bisoc*, — a favorite French form. It may be mentioned that the adaptability for mold-board turning is not (in France) for the purpose of plowing side-hills, but to enable the plowman to begin at the

Fig. 856.



Brabant Double Turning-mold-board Plow.

side of a field and plow furrow by furrow clear across, reversing the plow at the end of each furrow, — the ancient mode of plowing still common in the Orient. See BOUSTROPHEDON, *k*. Fig. 1613, p. 1655, "*Mech. Dict.*"

Dou'ble Wheel'-lathe. A lathe adapted to receive a pair of wheels while on their axle, as in the wheel-lathe, Fig. 7185, p. 2767, "*Mech. Dict.*"

Fig. 857.

Double Y Branch.

Dou'ble Whip. (*Nautical.*) A *whip* is a rope wove through a single block; in a *double whip* the rope passes through a lower or hook block, and the standing end is secured to the upper block or other point of attachment. See also Fig. 6159, p. 2480, "*Mech. Dict.*"

Dou'ble Y Branch. A triple pipe connection, one central and two branching, from a single main.

Dou'bling Wind'ing Ma-chine'. A machine used in thread manufacture to double and at the same time wind the doubled yarn, ingenuity being displayed in securing uniform winding speed notwithstanding the increasing diameter of the wound yarn.

Boyd's doubling winder, * "*Textile Manufacturer*," 1878; reproduced in "*Scientific American Supplement*," * 2179.

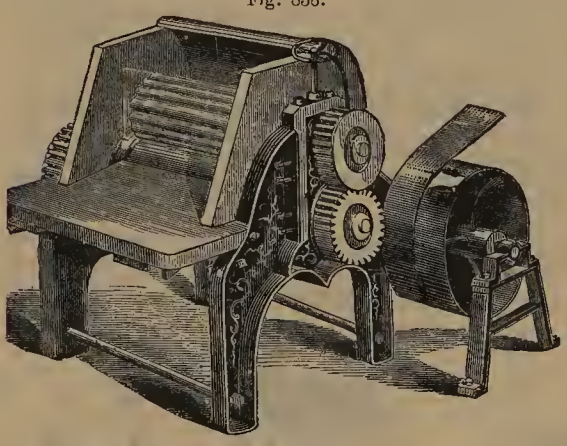
Douche. (*Surgical.*) A syringe constructed for special applications and deriving its name therefrom, as, —

Catarrhal.	Uterine.
Eye.	Vaginal.
Ear.	Hemorrhoidal.
Nasal.	Rectal, etc.

See Fig. 1727, p. 732, "*Mech. Dict.*"

Dough Brake. A bakery machine for kneading dough. It takes the material from the mixing machine, and makes it ready for the cracker machine. Dough brakes are *simple* or *return*. In the former case the dough is laid upon a table, passed between rollers, and discharged on to a lower shelf whence it is picked up and laid on the upper table for the repetition of the process. In the *return* dough brake the labor of lifting the dough is saved.

Fig. 858.



Dough Brake.

The dough is placed on the table, taken by the rollers, passed between the rollers, and carried over the upper one back to the table ready to be doubled and passed through again.

Dough Cut'ter. A circular cutter for stamping out cakes from a sheet of dough. A spring piston ejects the cake from the cutter.

Collins . . . . * "*Scientific American*," xxxiv. 355.

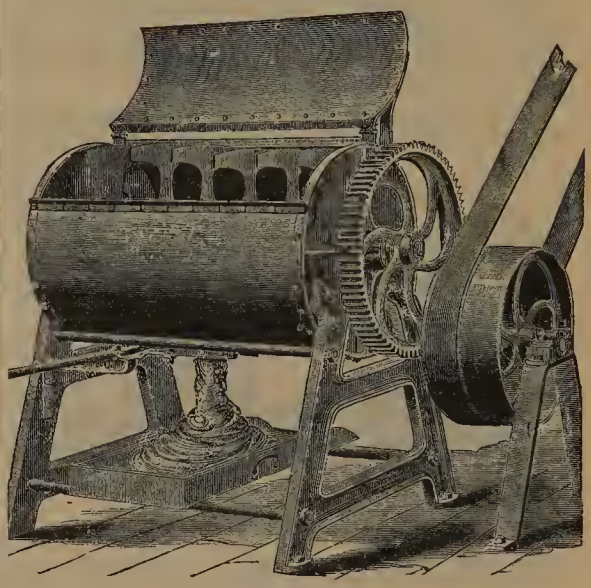
Dough Knead'er. A machine for incorporating dough: violent and repeated pressure is necessary. See DOUGH BRAKE. The name of the *brake* is from the pivoted lever upon which the weight of the man was formerly swung in the old method of preparing cracker dough.

The Durand dough kneader is an annular trough driven by steam, and with stirring devices which revolve in the trough while the latter revolves.

Pfleiderer, Br. . . . . * "*Engineering*," xxviii 483.
"*Scientific American*," xl. 246.

Dough Mix'er. A bakery machine for compounding the ingredients of bread, cake, crackers, as the case may be. The machine illustrated is for mixing soft cake dough, beating eggs, and preparing the dough for the machine which rolls

Fig. 859.



Ruger's Dough Mixer.

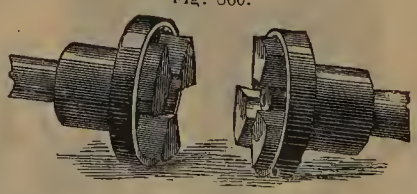
the paste, and cuts and pans the cakes. See CRACKER MACHINE. The dough mixer is a horizontal cylinder with an axis provided with arms which cut, stir, and intimately incorporate the materials. It is discharged below when the gate is opened.

The hard dough-machine is on the same principle, but the discharge of the much more solid dough is by a spout in the manner of a sausage-stuffer.

Doul'ton Ware. (*Ceramics.*) A ware with an ordinary clay body and the salt glaze of stone ware, made by Doulton, of London.

The pieces are thrown, not molded, and are highly artistic, being cut, carved, and incised, with small ornaments in body of another color, added in lines or bands. Some colored slips are used, and a few metallic oxides contribute to the richness of coloring which the final glazing in the open salt-glaze kiln imparts.

Fig. 860.



Dovetail Clutch-coupling.

Dove'tail Clutch'-coup-ling. A device in which the interlocking parts are formed of dovetails which, when the driving strain is brought to bear, draw together instead of pushing apart.

Dove'tail-ing Ma-chine'. A machine for cutting fan-tail tenons and corresponding mortises.

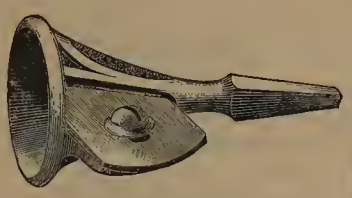
Armstrong . . . . "*Thurston's Vienna Report*," iii. 265.
Tighe-Hamilton, Br. * "*Engineering*," xxix. 386.
Hamilton, Br. . . . * "*Engineer*," xlvi. 47.
* "*Iron Age*," xvii., Jan. 6, p. 11.
Stengel . . . . * "*Engineer*," xlv. 435.
* "*Scientific American*," xxxviii. 246.

Dow'el Ma-chine'. A machine for turning dowels; the small cylindrical pegs wherewith jointed boards, table-leaves, or staves are connected. It is like a rod lathe, the stuff passing through the hollow head and turned by a chisel or by a special tool, a sort of hollow auger. *A rod, pin, and dowel machine*, Fig. 4394, p. 1961, "*Mech. Dict.*"

Dow'el Point'er. A hollow cone with a bit

projecting inwardly, into which a dowel is thrust to point or chamfer the end to facilitate its entrance in driving.

Fig. 861.



Dowel Pointer.

Draft Chain. A chain by which the draft of a plow-team is thrown back on to the part of the beam near the standard, instead of hitching direct to the forward end of the beam.

A draft rod answers the same purpose, and is shown in Fig. 3825, p. 1746, "*Mech. Dict.*"

Draft'ed Stone. (*Stone Cutting.*) Ashlar stone the face on which is surrounded by a chisel draft, the space inside the draft being left rough.

Draft'ing In'stru-ments. See list on p. 736, "*Mech. Dict.*," also the following references: —

Templet, *Davis*	* "*Sc. Am. Sup.*," 3757.
Easel, *Boudriot*, Ger.	* "*Sc. Am.*," xlii. 338.
Table	* "*Sc. Am.*," xxxviii. 114.
Instruments and pens	* "*Engineer*," xlvii. 453.
Pen, *Faber*	* "*Engineering*," xxx. 168.

See also list of Drawing, Writing, Copying Instruments and Processes on pp. 272, 273 *infra*. Also list under Graph, p. 1009, "*Mech. Dict.*"

Draft Reg'u-la'tor. A means of governing the energy of a fire by means of limiting the access of air thereto, or the egress of air therefrom: by devices, that is to say, which control the admission of air to the fire, or govern the sectional area of the chimney. Such is a *damper*. The subject is considered under Damper Regulator, which see.

Woodruff's draft regulator acts by pressure of steam on a diaphragm, excess of pressure closing a damper in the chimney to a regulated extent.

The "acme" draft regulator acts by displacement of water by steam. Patent, October 11, 1875.

For stoves, *Andrews*	* "*Scientific Amer.*," xxxviii. 339.
"Acme"	* "*Scientific Amer.*," xxxv. 179.
Franklin	* "*Scientific Amer.*," xlii. 231.
Turl	* "*Manuf. & Builder*," xii. 76.

Draft Tug. (*Harness.*) *a.* A trace.

b. A short section attached to the draft eye of the hame, and to which the trace proper is buckled.

c. A spring section in a trace to relieve the horse from sudden jerks.

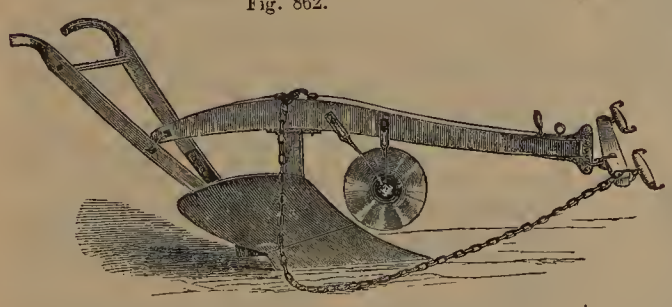
Smalley's	* "*Scientific American*," xlii. 100.

Drag. (*Spinning.*) A device to act as a gentle brake upon the rotation of a bobbin in throstle spinning and doubling frames. — "*Textile Manufacturer.*"

"*Scientific American Supplement*"	* 2705.

Drag Chain. A chain dragged by a plow in such a position as to gather and turn weeds and trash over into the furrow to be covered by the plow. Fig. 862 shows the mode of attachment.

Fig. 862.



Right Hand Plow with Rolling Colter and Drag Chain.

Not to be confounded with *draft chain*, which is a means of drawing the plow without hitching to the nose of the beam.

Drag Mill. (*Metallurgy.*) Another name for the arrastra. Blocks of porphyry are dragged aronnd in the pan. See Figs. 367–371, pp. 159, 160, "*Mech. Dict.*" See also Amalgamator, *Ibid.*

Drag Saw. A cross-cutting saw for logs. The fact that the cut is upon the *draw* and not upon the *thrust* motion is the occasion of the name. See Fig. 1522, p. 649, "*Mech. Dict.*"

Alters & Basington	* "*Scientific American*," xli. 21.
Giles	* "*Scientific American*," xli. 230.

Drail'ing Tack'le. (*Fishing.*) A trawling tackle, the line with bait, real or artificial, being towed over the surface by the moving boat.

Drails. A jig or artificially-baited hook, used in trawling.

Drain'age. See notices under the following: —

Haarlem Mere	* "*Mech. Dict.*," pp. 116, 739.
House,	* "*Scientific Am. Sup.*," 2850.
Willett	* "*Scientific Am. Sup.*," 509
Lac Fetzara, Italy, *Bure*	"*Technologiste*," xli. 802.
Lac Fucino, *Durant-Claye*	"*Technologiste*," xl. 32–38.
	* "*Engineering*," xxi. 17, 33; xxii. 517; * xxvii. 249.
	"*Van Nostrand's Mag.*," xviii. 437.
	"*Sc. American*," xl. 10.
Mines, 16 figures, Br.	* "*Engineer*," xliv. 332.
Pipe machine	* "*Eng. and Min. Jour.*," xxvi. 419.
Pipe making	* "*Sc. Amer.*," xxxviii. 31.
	* "*Sc. Amer. Sup.*," 1048.
St. Germain sluice	* "*Engineer*," xlvi. 127–130.
Zuyder Zee	* "*Engineer*," xli. 2.
Engines	"*Sc. Am. Sup.*," 126, 127, 136, 137.
Plat	* "*Eng. & Min. J.*," xxvi. 133, 151.
	"*Sc. American*," xxxiv. 193
	"*Sc. Am. Sup.*, 1232.

Consult: *Klippart's* "*The Principles and Practice of Land Drainage.*" Cincinnati, 1868.

Dempsey's "*Draining Districts and Lands.*" "*Drainage and Sewerage of Towns and Buildings.*"

Elkington's "*A Systematic Treatise on Draining Land*," London.

French's "*The Principles, Process, and Effects of Draining Lands, etc.*"

Drain'age In'stru-ments. (*Surgical.*) Specifically, tubes placed in a wound to withdraw pus.

Inclusive also of trocars, canulæ, and aspirators in one of their functions. See Fig. 6665, p. 2629, "*Mech. Dict.*"; and Figs. 120, 121, p. 52, *supra.*

Instruments for *paracentesis abdominis* are given on p. 162, Part III., *Tiemann's* "*Armam. Chirurgicum*," including: —

Drainage trocar.	Clamp Forceps.
Drainage tubing.	Trocars.
Drainage spiral.	Aspirator needles, etc.

Instruments for *paracentesis corneæ*, *Ibid.*, p. 29, Part II.
Instruments for *paracentesis thoracis*, *Ibid.*, p. 131, Part I.

Drain'age Tent. A dilating instrument introduced into the cervix uteri.

The uses and value of sponge, sea-tangle (*laminaria*), tupelo, and solid and tubulous tents, discussed by *Dr. Sussdorf*, "*Richmond & Louisville Medical Journal*," May, 1879.

Drain'age Tube. A tube introduced into a wound to form a means of discharge of matter.

Dr. J. B. Hamilton's drainage-tube carrier consists of a stylet, with a hook at the end within a canula; the stylet is moved by a button over a side slot in the cannla.

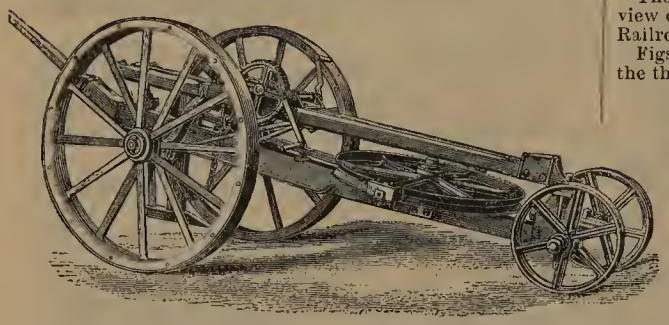
Drain Cock. A faucet attached to a cylinder to draw off water of condensed steam.

Drain Clean'er. A long-handled spade, the blade set on at an angle in order to be able to reach the bottom of a ditch when standing on the surface of the ground. See Ditch Cleaner.

Drain Gage. A device to measure the percolation of moisture — rain, liquid manure, etc. — through soil, and involving elaborate apparatus, is erected at Rothamstead, England, and a description is given in "*Scientific American Supplement*," * 1607.

Drain Grate. A grid at the entrance of a sewer in a yard or street.

Fig. 863.



Steam Draining Plow. (*Fowler & Co*)

Drain'ing Plow. (*Steam Culture.*) A plow for opening furrows or drains for water. Fig. 863 shows the Fowler draining plow, adapted to be drawn by the plow-engine, which is applicable to various duties of steam husbandry.

It is drawn by the winding engine and rope; see Fig. 5706, p. 2354, "*Mech. Dict.*" It is used either as a mole plow, or to put in drain tile, and is worked to a depth of 42″. The wire rope passes over the sheave, and so draws the plow at hut half the rate that it would were it hitched directly to the front of the implement.

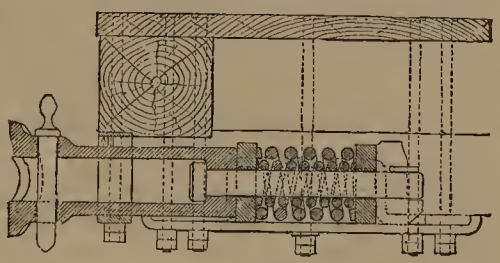
See also DITCHING MACHINE, and items in lists of AGRICULTURAL IMPLEMENTS, "*Mech. Dict.*," and *supra*.

Drain Tile Lay'er. *a.* A long handle with a piece projecting at right angles from the lower end, to place in position drain tile at the bottom of a trench.

b. Some forms of draining machines also lay tile. Some are noticed on p. 741, "*Mech. Dict.*"

Drain Tile Ma-chine'. See TILE MACHINE.

Fig. 864.

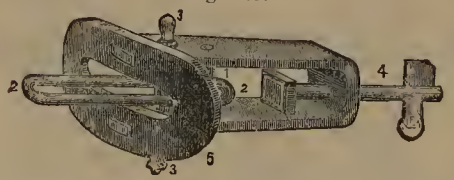


Draw Gear for Freight Cars. (*Pennsylvania Railroad.*)

Drain Trap. A device at the opening of a drain or sewer to allow passage to liquids by preventing emission of gases.

Banner, Br. . . . . * "*Engineer*," xli. 51.

Fig. 865.



Bolt Draw Bar.

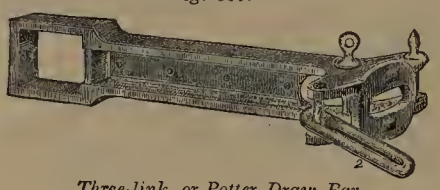
1. Coupling-link Rivet.
2. Fast Coupling-link.
3. Fast Coupling-pin.
4. Draw-bar Bolt.
5. Draw-bar Face-plate.

Draw Bar. (*Railway.*) An open-mouthed bar at the end of a car to which the coupling-links are attached, and with which the car is drawn. The draw-bars are usually provided with springs to give elasticity to the connection between the cars, and arranged so as to resist both the tension and compression to which the draw-bar is subjected. — *Forney.*

These springs are shown in the longitudinal sectional view of the draw gear for freight cars of the Pennsylvania Railroad, Fig. 864.

Figs. 865 and 866 are respectively the bolt draw bar, and the three-link, or *Potter* draw bar.

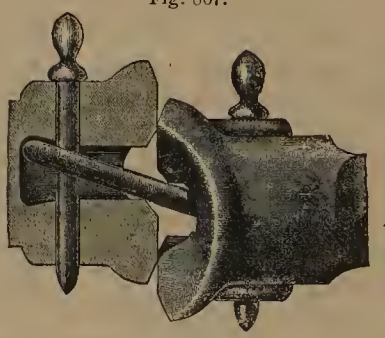
Fig. 866.



Three-link, or Potter Draw Bar.

Fig. 867 is a safety draw bar, which accommodates itself to draw heads of varying height.

Fig. 867.



Safford's Safety Draw Bar.

Continuous, *Griffith & Patterson* * "*R. R. Gaz.*," xxi. 559.
Hibbert . . . . . * "*Sc. Amer.*," xliii. 226.
Safety, *Potter* . . . . . * "*R. R. Gaz.*," xxii. 315.
Safford . . . . . * "*R. R. Gaz.*," viii. 164.

Draw'bridge. A bridge capable of being moved to leave a free channel for vessels. They are *lifting, swing or turning, bascule, rolling.* See pp. 241, 742, 1721, 1965, "*Mech. Dict.*," and references; also list on p. 380, *Ibid.*

Harlem . . . . . * "*Man. & Builder*," xi. 6.
Lifting . . . . . * "*Man. & Builder*," xi. 29.
Thames, proposed . . * "*Scientific Amer. Sup.*," 290.

Draw'ing. (*Add.*) 5. (*Glass.*) Glass is drawn into tubes or sticks by attaching a ponty to the end of a bulb held on the blowing tube, and running away with it; so that the glass is elongated between the ponties held by the respective men.

In drawing tubes, the glass is blown to a globe, so that as the workman runs off the stick is hollow; the thickness of the glass and bore of the tube are regulated by the quantity of metal in the globe, the size of the latter, and the rate of the motion of the retreating workman.

The stick or tube is constantly rotated, and when the workman has attained his distance the glass is laid on the floor to cool straight. It is divided into lengths by cold tongs. Such tubes furnish the material for heads.

Draw'ing, Writ'ing, Cop'y-ing In'struments and Pro'ces-ses. See under the following heads: —

Albertype.
Autographic process.
Autopolygraph.
Bank note engraving.
Beam compass.
Bevel protractor.
Blind ink.
Blue process, for copying.
Brush.
Camera lucida.
Camera obscura.
Carbon printing.

Carbon process.
Charcoal pencil.
Chromophotograph.
Composite portraits.
Copygram.
Copygraph.
Copying devices.
Copying ink.
Copying pad.
Copying paper.
Copying pencil.
Copying press.
Copying processes.
Crayon cutter.
Crayon mold.
Curve delineator.
Curve instrument.
Curve scribe.
Curvograph.
Cyclograph.
Cycloidograph.
Diagraph.
Dividers.
Easel.
Electric pen.
Ellipsograph.
Engraving.
Engraving, Electric.
Engraving and chasing machine.
Engraving machine.
Etching liquids.
Fountain pen.
Galvanoplastic process.
Gelatine process.
Hectograph.
Heliogravure.
Horograph.
India ink.
Ink.
Ink eraser.
Ink marks, Removing.
Ink pencil.
Ink powder.
Ink, Restoring faded.
Inkstand.
Ink, Sympathetic.
Lithogram.
Lithographic crayon.
Lithographic ink.
Manigraph.
Microscopic-drawing apparatus.
Mucilage brush.
Odograph.
Pantograph.
Papyrograph.
Pen.
Pencil.
Pencil, Indelible.
Perspective.
Perspective lineal.
Perspective ruler.
Perspectograph.
Photo-collograph.
Photo-collotype process.
Photo-engraving.
Photographic printing surface.
Photographic relief process.
Photolithography.
Photo-mezzotint engraving.
Photo-printing process.
Phototype.
Photozincotype.
Planigraph.
Pneumatic pen.
Point finder.
Polar pantograph.
Polytype.
Porotype.
Profilograph.
Proportional dividers.
Protractor.
Pyrostereotype.
Quill.
Quill manufacture.
Radiograph.
Reducing squares.
Reflecting drawing board.
Relief process.
Shading pen.
Short-hand writing machine.
Sketching frame.
Slate pencil.
Steel pen.
Stencil paste
Stencil pen.
Stenochrome.
Stylographic pen.
Sun engraving.
Tablet.
Tracing apparatus
Tracing copying.
Tracing table.
Voltaic pencil.
Woodburytype.
Writing multiplier.
Writing, Restoring faded.
Zincography.

Draw'ing Hook. A clutch-hook used in lifting well-rods.

Fig. 868.

Drawing Hook.

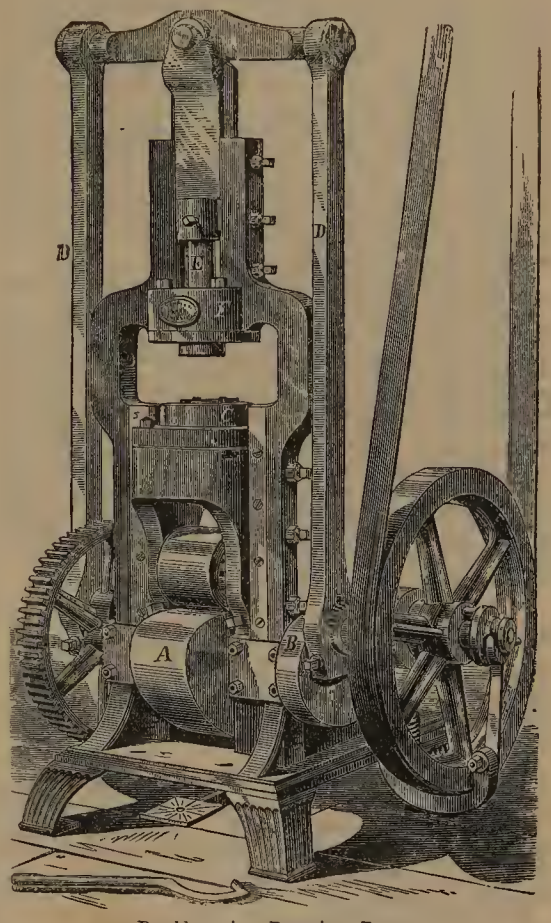
Draw'ing Ma-chine'. (*Add.*) 4. (*Cartridge Making.*) In making fixed ammunition in the United States factories there are five draws to the shell, coming in consecutive course. These machines elongate the shell and lessen its diameter by means of vertical dies descending into depressions beneath. The shells are fed into each machine on a horizontal wheel.

Drawing machine for cutters, Figs. 1-5, "*Engineering*," xxx. 484.

Draw'ing Press. A machine for cutting and drawing sheet metal into hollow ware. In making articles of moderate size it cuts the blank and forms the article at one operation. The work ranges from lantern bottoms, rim-covers, patty-pans, pie-plates, etc., up to 30-quart dish-pans and equally large work of other descriptions.

Power is communicated to the large pulley on the right, which, by means of a simple clutch, operated by the treadle shown under the bed, is thrown into or out of gear at will. From this pulley power is transmitted to a horizontal shaft passing through the lower portion of the frame, on which shaft is a heavy cam, *A*, and also two cranks *B*. The cam, in its revolution, acts upon a roll above it, and so elevates the carrier *C*, of the cutting and drawing dies, which carrier travels in slides in the frame. To the cranks are connected pitmen, *D D*, which connect with a wrought-iron yoke, to which is secured the drawing punch-rod, *E*. At *F* is a cross-

Fig. 869.



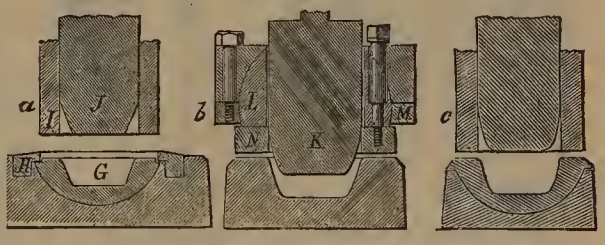
Double-acting Drawing Press.

piece between the two sides of the frame, through which piece operates the cutting-punch.

When the cam-shaft is rotated, the cam raises the die carrier, and the cranks, pulling down the pitman, force the cutting-punch against the metal and into the die below. This will be more clearly understood from the section *a*, Fig. 870, in which *G* is the drawing die, *H* the cutting die, *I* the cutting-punch (stationary), and *J* the drawing-punch. As the die carrier rises, the metal is first pressed against the cutting-punch *I*, between the outer edge of which and the cutting die *H* it is quickly cut, and the punch *J*, entering the die, then holds the edges so cut out as in a vise. At this point the drawing-punch *J* comes down and forces the metal into the drawing die *G*, thus completing the operation.

To obviate the difficulty incident to working in sheet metal not of uniform thickness, in which case the metal will be imperfectly held between the rising die and the stationary cylin-

Fig. 870.



Sectional Views of Drawing-press Dies.

der *I*, the lower portion of the drawing die *G* is made hemispherical so as to form a ball-and-socket joint, which enables the upper face to correspond with the face of the cutting-punch *I*, notwithstanding some slight difference in the thickness of the intervening sheet-metal. The device shown in section *a*, Fig. 870, is especially intended for small ware.

The arrangement shown at *b*, the same figure, is intended for large pans and like objects. In this there is no cutting of the metal by the machine, this having been previously done; there is, therefore, no cutting-die nor punch in this style of machine. The drawing die is a simple concavity

without peculiar features, the essential points of the device being found in another means of holding the edge of the blank. The punch *K* passes directly through the ball portion, *L*, which is confined by a ring, *M*, held by the screw bolts, one of which is shown on the left. The edges of the blank are compressed and held between the surface of the die and a lower ring, *N*, which is upheld by another set of screw bolts, one of which is shown on the right. These bolts pass through a large bore in the ball portion, *L*, thus allowing the latter its free play and shoulder in said ball, as shown, so that the latter and the ring are closely united. The ring *N*, therefore, follows the play of the spherical portion, and consequently automatically adapts itself to the thickness of the metal. The punch then descends in manner similar to that already described.

c, Fig. 870 is a section of a simpler form of drawing press without cutter, but possessing the adjustable feature of *a*.

Referring to Fig. 869, it will be observed that the lower slide *C* is carried up by the cam *A* on the main shaft, and the shape of the cam is such that the slide dwells after cutting the blank, while the die on the lower end of the plunger *E* forces the sheet-metal into shape. The upper slide is brought down by the yoke *G*, operated by the pitmen *D D*, from cranks *B* on the main shaft. Thus it will be seen that the strain at the critical moment comes on the main shaft, pitmen, and yoke, —all of steel or wrought iron,— relieving the cast-metal frame. The frame bows at the point where the drawing takes place, thus affording a slight spring and a wider space in which to manipulate the blanks and the ware. See the following references: —

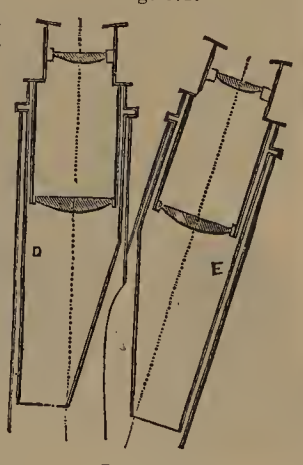
Bliss & Williams . . .	* "*Iron Age*," xvii., April 13, p. 1.
	* "*Iron Age*," xxv., May 6, p. 1.
	* "*Scientific American Sup.*," 546.
Deep work	* "*Iron Age*," xxiii., Mar. 13, p. 1.
	* "*Iron Age*," xxiii., June 5, p. 1.
Double-crank	* "*Iron Age*," xix., Feb. 8, p. 1.
Inclined	* "*Iron Age*," xxi., March 7, p. 3.
Ferracute Machine Co. .	* "*Iron Age*," xviii., Sep. 7, p. 1.
	* "*Iron Age*," xxv., April 8, p. 1.

Draw'ing Splice. (*Nautical.*) Used for cables. Made by unlaying several fathoms of the two ropes to be joined, making a short splice, then tapering the ends of the strands and laying them along in the contlines of the rope, where they are secured by seizing.

Draw Stop. (*Music.*) The mechanism in an organ, by drawing out which the organist makes such and such a stop speak. See STOP, "*Mech. Dict.*"

Draw Tube. (*Microscope.*) A means for increasing the magnifying power of the microscope by lengthening the distance between the object-glass and eye-piece without changing for lenses of different power.

Fig. 871.

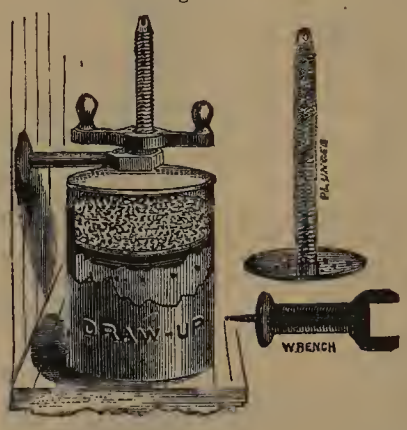


Draw Tube.

Fig. 871 shows the draw-tubes *D E* of a binocular microscope.

Draw'-up Press. A small domestic press for jelly, fruit, or what not, in which the platen is drawn up by a screw, and presses the material against the lid, leaving a space beneath in which the liquid expressed may collect. Fig. 872.

Fig. 872.



Draw-up Press.

Dredge. A machine for excavating the bottom of a river or channel to increase the depth and facilitate navigation.

The Eads dredging machine is a sort of plow with a throat, comparable to a carpenter's plane, 4′ in width, and with arrangements for limiting the depth of its cut on the silt of the river-bottom, so that the silt and water shall bear a quantitative relation, the silt occupying so much of the 16″ of throat as the nature of the plowed-up material shall warrant. An Andrews cataract pump of 27″ diameter suction is the lifting apparatus, and the discharge is into tanks of 1,000 tons capacity, with overflows for water as the silt settles to the bottom.

The dredge-boat is 200′ in length, propelled by horizontal high-pressure engines, each 7′ stroke and 21″ diameter, turning paddle-wheels 28′ diameter. It is designed to move at the rate of from 10,000′ to 15,000′ per hour.

Adelaide, Australia.	
Simons	* "*Engineer*," xli. 460.
	"*Scientific American*," xxxv. 146.
	"*Scientific Amer. Sup.*," 2683.
Antwerp	* "*Engineering*," xxviii. 389.
"Atlanta Dredging Co."	"*Trans. Am. Soc. Civ. Engineers*," vii., No. clxxiv.
Buckets, *Kinipple*, Br. .	* "*Engineer*," xliv. 273.
	* "*Scientific Amer. Sup.*," 1583.
Simons, Br.	* "*Scientific Amer. Sup.*," 2683.
Calcutta, dredge and fire-engine boat . . .	* "*Engineering*," xxviii. 265.
Carr	* "*Scientific Amer.*," xxviii. 390.
Danube improvements .	* "*Engineering*," xxvi. 147, 235.
Davis	* "*Scientific American*," xxxvi. 50.
Dennison, "Iugurgitator" (suction)	* "*Min. & Sc. Press*," xxxv. 121.
	* "*Scientific American Sup.*," 1488.
Eads, Mississippi . . .	"*Manuf. & Builder*," x. 35.
	* "*Iron Age*," xx., Aug. 9, p. 1.
Holland, *Reitscholen et al.*	* "*Scientific Amer.*," xxxvii. 259.
Kurrachee, India . . .	* "*Engineering*," xxix. 341.
Lake Fucino	* "*Engineering*," xxi. 17.
	* "*Scientific Amer. Sup.*," 120.
Newton (suction) . . .	* "*Min. & Sc. Press*," xxxv. 241.
	* "*Scientific Amer. Sup.*," 1583.
Patna Canal, India.	
Fouracres	* "*Engineer*," xlviii. 199, 202.
Pneumatic	* "*Scientific American*," xxxvii. 371; xxxiv. 179.
Pneumatic, Millwall, Br.	"*Iron Age*," xvii., April 6, p. 23.
Roy Stone	* "*Eng. & Min. Jour.*," xxviii. 454.
Toulon, graving dock .	* "*Engineering*," xxvii. 136, 376, 432.

See also EXCAVATOR, *infra*, and figures on pp. 747–749, and 814, "*Mech. Dict.*"

(*Add.*) 2. (*Fishing*). A rake or scoop, with a net attached, drawn with open mouth in the wake of a vessel to gather oysters or flat-fish, coral, or other objects. See TRAWL NET.

Fig. 873 shows the *dredge* and *tangles* of the expedition ship "Challenger."

Dredg'ing Tube. A tube which is lowered from a vessel or scow and burrowing in the silt removes it by means of a connected steam-pump which draws up the solid portions together with water.

This is a feature common in pneumatic dredgers; see list of references under DREDGE. See also Figs. 1762, 1763, p. 749, "*Mech. Dict.*"

One form is a closed tube which is lowered into position and then filled by exhausting the air by pump; after which the tube is lifted and discharged, shown in * "*Scientific American*," xxxvii. 371.

Fig. 873.

Dredge and Tangles of the "Challenger."

Dres'ser. 1. (*Mining.*) A heavy pick used for preparing the large bunches of ore for loading on the skips.

2. A plumber's wooden mallet, or rather paddle, for closing sheet-lead joints.

Dres'sing For'ceps. (*Surgical.*) An instrument used in applying and removing dressings.

Fig. 873.

Bayonet-curve Dressing Forceps.

Dress'ing Ta'ble. 1. (*Stereotyping.*) A machine for straightening and trueing the edges of stereotype plates; and for beveling and cutting off curved plates for newspaper work and for perfecting presses. See figures on pp. 2378–2381, "*Mech. Dict.*"

2. A brickmaker's table on which bricks are dressed, to make them symmetrical for house-front courses. Fig. 1764, p. 749, "*Mech. Dict.*"

3. A bench on which copper or other ores are hammered, and sorted into qualities.

Drift Net. (*Fishing.*) A gill net suspended from a cork line and having leads at its lower edge. A float at each end carries a lantern and it floats with the tide or current. Such a net is usually 300 yards long, and a number of such are cast parallel with an intervening space of 50 to 80 feet. The gilling ground of the Chesapeake Bay is famous.

Drill. 1. (*Surgical.*) A boring instrument in operations in osteotomy.

Brainard's, Tiemann's, Hamilton's, Howard's, and *Buck's* drills are shown on p. 8, Part I., *Tiemann's "Armamentarium Chirurgicum."*

See list under Surgical Instruments, "*Mech. Dict.*" *et infra.*

Drill for ununited and oblique fractures, *Ibid.*, Fig. 61, Part I.

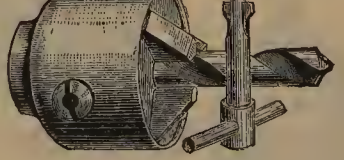
2. (*Dentistry.*) A boring tool used in mechanical or operative dentistry. See Dental Drill, *supra,* and Fig. 1609, p. 685, "*Mech. Dict.*"

3. (*Machinery.*) A boring tool for metals. See pp. 750–752, "*Mech. Dict.*," and the following references: —

Boiler work, *Adamson,* Br.	* "*Engineering,*" xxvi. 434.
Allan, Br.	* "*Engineering,*" xxvi. 434.
Brown, Br.	* "*Engineering,*" xxvi. 434.
Buckton & Co., Br. . .	* "*Engineering,*" xxvi. 414.
Buckton & Wickstead, Br.	* "*Engineering,*" xxvi 414.
Dickenson, Br.	* "*Engineering,*" xxvi. 434.
Hall, Br.	* "*Engineering,*" xxvi. 434.
Hutchinson, Br.	* "*Engineering,*" xxvi. 414.
Jordan, Br.	* "*Engineering,*" xxvi. 414, 434.
Kennedy, Br.	* "*Engineering,*" xxvi. 434.
McKay, Br.	* "*Engineering,*" xxvi. 414.
Thorn, Br.	* "*Engineering,*" xxvi. 434.
Welch, Br.	* "*Engineering,*" xxvi. 414.
Car truck frame, *Bement.*	* "*Scientific Amer.,*" xxxvi. 226.
Chuck. See Drill-chuck.	
Chucking, *Pratt & Whitney*	* "*Engineer,*" xlii. 42.
Cleaner, *Prentiss*	* "*Scientific Amer.,*" xliii. 85.
Forms and principles . .	* "*Scientific Amer.,*" xxxix. 387.
Machine, *Adt*	* "*Iron Age,*" xxii., Oct. 24, p. 1.
Bement	* "*Engineering,*" xxi. 552.
	* "*Scientific Amer. Sup.,*" 582.
Ferris & Miles	* "*Engineering,*" xxi. 437.
Notes on early, Br. . .	"*Engineering,*" xxvii. 534.
Pratt & Whitney . . .	* "*Engineer,*" xlii. 24.
Sharpe, Stewart & Co., Br.	* "*Engineering,*" xxvi. 518.
Treatise on	"*Iron Age,*" xix., Feb. 1, p. 7.
Hall	* "*Engineering,*" xxvi. 414.
Multiple, Br.	* "*Scientific Amer.,*" xxxiv. 191.
Oil wells	* "*Scientific Amer. Sup.,*" 1644.
Power, *Pratt & Whitney* .	* "*Manuf. & Builder,*" xii. 16.
Press, *Ferris & Miles* . . .	* "*R. R. Gazette,*" xxi. 119.
Recessing mach., and, duplex, *Kershaw,* Br. . .	* "*Engineer,*" xlii. 429.
Self-feeding, *Combs & Bawden,*	
Pratt & Whitney . . .	* "*Scientific Am.,*" xxxvii. 278.
	* "*Iron Age,*" xx., July 12, p. 11.
Slotting mach., and, *Lowry*	* "*Engineer,*" xli. 122.
	* "*Scientific Amer. Sup.,*" 248.
Square hole, *Hall* . . .	"*M. & Sci. Press,*" xxxvii. 291.
	* "*Scientific Amer.,*" xxxix. 311.
Stone working	* "*Sci. Amer. Sup.,*" 1796, Fig. 18.

Drill Bench. See Bench Drill.

Fig. 874.



Cushman's Drill Chuck.

Drill Chuck. A lathe-drill holder. Figs. 874, 875, 876, show various drill-chucks.

Almond	* "*Sc. American,*" xxxv. 6.
Brown & Sharpe . . .	* "*Polytech. Rev.,*" Jan. 27, 1877.
Chucking, On	* "*Scientific American,*" xl. 52.
Horton	* "*Polytech. Rev.,*" Jan. 27, 1877.
	* "*Scientific American,*" xlii. 383.
Planer chuck	* "*Sc. American,*" xxxviii. 245.
Pratt, "Victor" . . .	* "*Iron Age,*" xxi., Feb. 28, p. 1.
	* "*Sc. American,*" xxxv. 210.
Self-centering	* "*Sc. American,*" xxxvi. 406.
Sweetland & Horton . .	* "*Iron Age,*" xxiv., Nov. 6, p. 1.

Drill Hold'er. A lathe rest or fork-attachment, or both, to hold a drill in position, or steady it, while held up to its work by the tail center.

"*Scientific American*" . . . . . * xl. 164, Fig. 22.

Dril'ling Clip. A vise or clamp to clasp a gas or water main, and having an arm on its upright shaft to form the upper bearing for a brace or ratchet drill. Fig. 877.

Dril'ling Scow. A vessel fitted up with apparatus for subaqueous drilling.

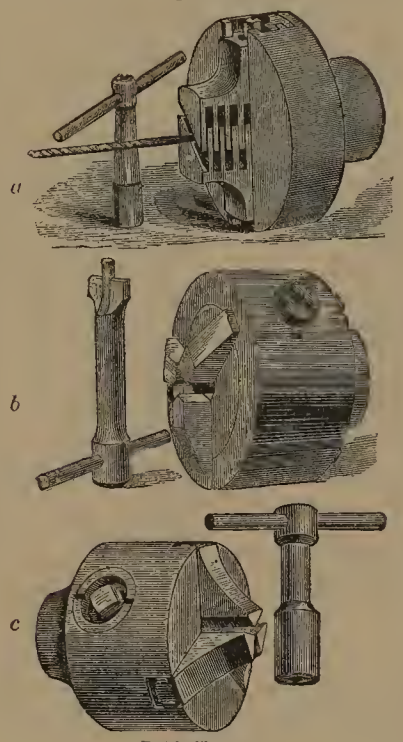
The drilling scow, built for excavating the channel for the improvement of the Des Moines Rapids, is shown in the "*Report of the Chief of Engineers, U. S. Army*," 1880, * ii. 1556.

See also drilling platform and scow, Ahnepee Harbor, Wis.; "*Report of Chief of Engineers*," 1879, * i. 1510.

The United States drilling scow, East River, N. Y., is shown in "*Scientific American*," * xli. 131.

See also Report by *Sir John Hawkshaw* on the Hydraulic Engineering Group, British Reports on the Centennial Exhibition, 1876.

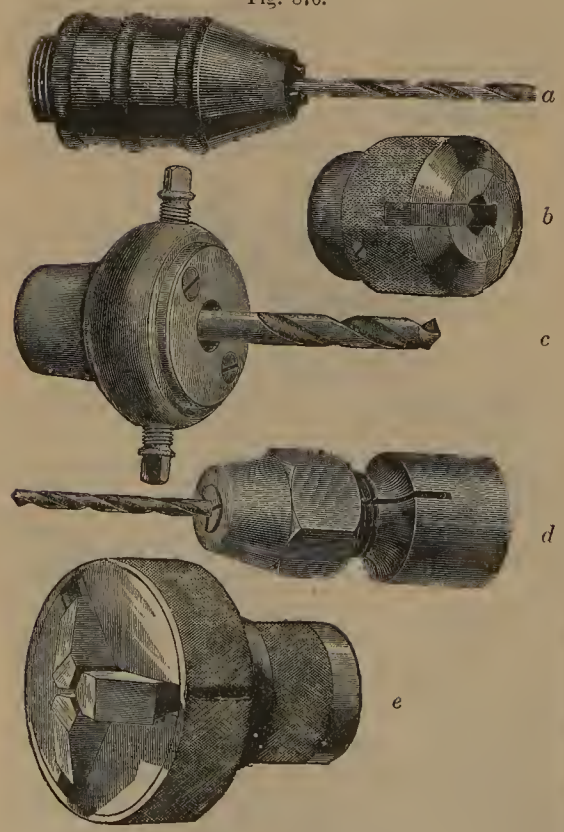
Fig. 875.



Drill Chucks.

a. "Oueida" chuek.
b. "Danbury" chuck.
c. *Whiton* chuek.

Fig. 876.



Drill Chucks.

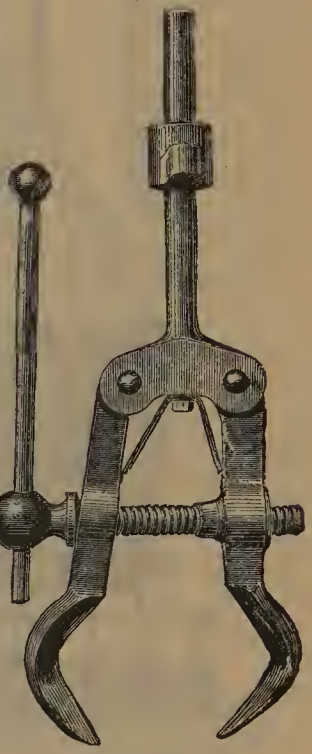
a. *Beach* chuck.
b. Adjustable drill ehuek.
c "1876" ehuek.
d. Center drill chuck.
e. "Acme" chuck.

Drip Pump. A plumber's pump for removing drip or collections of water incident to accidents to pipes or in clearing up after work.

Fig. 878.

Evarts' Drive Chain.

Fig. 877.



Drilling Clip.

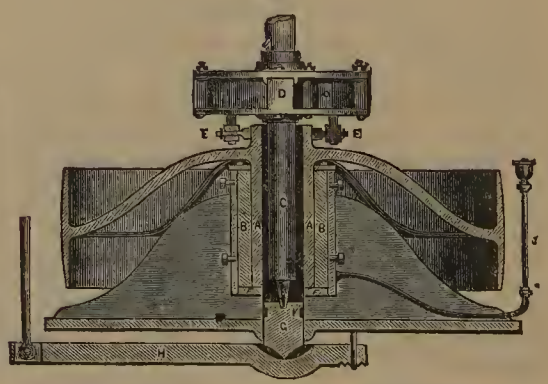
Drive Chain. A detachable link chain used in connection with sprocket wheels, to drive machinery. Each link has a hook and bar at its respective ends, and these may be connected in certain relative position, but cannot be detached when stretched. Fig. 878.

Drive Well. A tube driven into an aqueous stratum, and forming the stock for a pump attached to its upper end.

See notices. * "*Iron Age*," xxi., Jan. 31, p. 3; Feb. 7, p. 3.
"*Scientific American*," xxxv. 17.
In England . * "*Scientific American Sup.*," 1697.
Paper by *Palmer*, "*Scientific American*," xxxix. 408.

Dri'ving Pul'ley. One receiving motion from a belt, and concerned in driving machinery: as distinguished from a *loose* pulley, which runs free on the shaft, and does not communicate motion. The belt is shifted from the *loose* to the *driving* pulley when the machine is to be started, and *vice versa*.

Fig. 879.



Hafner's Equilibrium Driving Pulley, for Millstones.

Hafner's equilibrium driving pulley, designed for driving mill-stones, is intended to prevent the side draft of the belt on the pulley from putting the stone out of tram. The hub *A* of the pulley works in the bearing *B*, which rests on the bridge-tree *H*, by means of the step *G*. *C* is the spindle of the stone resting on *G*, and *E E* are drivers on the hub, which project upward into the jaws *D* of the coil spring. The arms of the pulley are curved down, so that the strain of the belt is on the center of the bearing *B*, and the side strain does not communicate to the spindle, as the drivers *E* have a freedom of motion in the jaws of the spring.

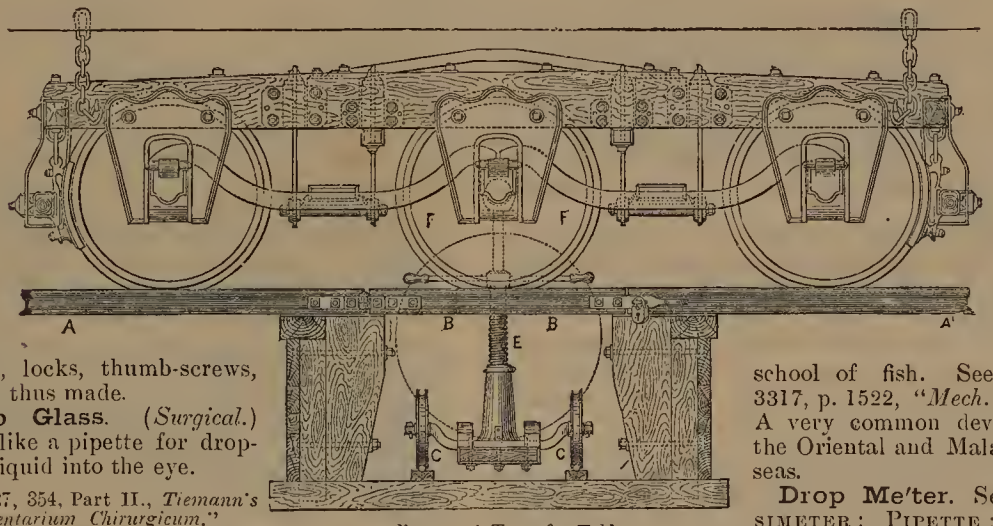
Dri'ving-wheel Brake. (*Railway.*) One applied directly to, usually between, the driving-wheels of a locomotive. Fig. 749. *Forney's "Car-builder's Dictionary,"* p. 475.

Drogue. A drag-anchor, thrown overboard from a vessel to keep a ship's head to the wind when drifting. See DRAG ANCHOR, * p. 737, *"Mech. Dict."*

Drop and Trans'fer Ta'ble. (*Railway.*) An arrangement for taking out the wheels of car trucks without removing the trucks from under the car.

Kirby's arrangement is shown in Fig. 880, which gives a side elevation of the truck and a section of the pit, which is transverse to and below the line of rails. The drop table is a truck, *C*, which runs on wheels on a rail under and transverse to the main line of rails, *A*, and has a screw-jack, *E*, which is brought beneath the axle of the pair of wheels, *F*, to be removed. These being lifted, a hinged section, *B*, of the rail is swung open, and the pair (*E*) of wheels lowered into the pit, as shown by dotted lines, the transfer moved off, and a new pair introduced in a corresponding manner.

Fig. 880.



Drop and Transfer Table.

Drop Bot'tle. One for using in small quantities iodine, creosote, acids, etc., in the laboratory.

Warm the bulb over the flame of a spirit-lamp, or in warm water, to expel the air, immerse the point of the pipette in the liquid, and the latter will ascend as the air condenses. When cool, place in the bottle, which should have enough of the liquid to cover the point of the pipette.

When required to be used take it from the bottle, and the warmth of the hand on the bulb will force the liquid out a drop at a time.

See also DOSIMETER; BURETTE; PIPETTE, etc.

Fig. 881.

Drop Bottle.

Drop Cut'-off. (*Steam.*) That form of cut-off in which a weighted bar is released at a regulatable point, and by its fall closes the valve. The Corliss arrangement is a familiar instance.

Drop For'ging. One made in that form of press in which the blow is by impact instead of by mere pressure. A forging made by a drop hammer.

Parts of sewing machines, watches, guns, pistols, drill-chucks, spinning rings, wrenches, clinch rings, shuttles, locks, thumb-screws, etc., are thus made.

Drop Glass. (*Surgical.*) A tube like a pipette for dropping a liquid into the eye.

Figs. 27, 354, Part II., *Tiemann's "Armamentarium Chirurgicum."*
See also DROPPER; DOSIMETER, *infra.*

Drop Ham'mer. A swaging hammer having a vertical motion in guides, or suspended by spring connection from a reciprocating portion. See DEAD STROKE HAMMER, DROP PRESS, *"Mech. Dict."*

See following references: —

Hasse, Br.	* *"Engineering,"* xxviii. 396.
Hill	* *"Scientific American,"* xxxv. 67.
Hotchkiss & Stiles .	* *"Thurston's Vienna Report,"* ii. 237.
Peek	* *"Iron Age,"* xxi., May 2, p. 41; xxii., Dec. 5, pp. 24, 29.
Pratt & Whitney . .	* *"Eng. & Mining Jour.,"* xxi. 298.

Drop-lev'er Scales. A weighing scales with a lever to raise the platform entirely off the working parts of the scale while it is being loaded.

Drop Light. A gas-light vertically adjustable to bring it from a chandelier to convenient table-height.

Taylor	* *"Scientific American Sup.,"* 1363.

Drop Net. (*Fishing.*) A net suspended over the water, and dropped vertically over a passing school of fish. See Fig. 3317, p. 1522, *"Mech. Dict."* A very common device in the Oriental and Malaysian seas.

Drop Me'ter. See DOSIMETER; PIPETTE; BURETTE; DROPPER, etc.

Drop'per. 1. (*Agric.*) A form of reaper in which the grain falls backward from the knife on to a slatted frame which is *dropped* at intervals to discharge the gavel. As the rear-end of the frame drops to the ground the heads of the cut grain catch in the stubble, and the gavel is pulled off in a compact bunch of a width equal to the length of the knife-bar. The dropping is done automatically at regulated intervals, or can be operated at the will of the driver. When the dropper falls, a horizontal rod descends temporarily to arrest the falling grain so that it shall not trail off at the rear of the gavel. When the dropper rises the rod also ascends and allows the grain to fall freely and collect on the dropper. See middle figure, Plate XLVI., p. 1892, *"Mech. Dict."*

2. A pipette. A tube with a small aperture at its lower and an elastic bulb at its upper end. Fig. 882. By compressing the bulb, and plunging the lower end into a liquid, the tube is filled, and the liquid ejected in drops by gentle compression of the bulb.

Drop'ping Tube. A *pipette, burette,* or *dosimeter.* See DROPPER.

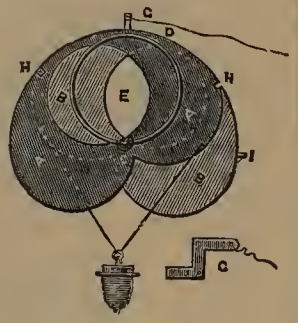
Drop Shut'ter. (*Photography.*) An arrangement for giving a very rapid exposure to a plate in instantaneous photography.

Fig. 882.

Dropper.

It is essentially constructed of two heart-shaped disks, *A A*, revolving on one axis, which is attached to the lower part of the mount of the lens. These two plates, when released by the trigger, have a reciprocal motion imparted to them by means of the weight *F*, which hangs suspended from the upper part of each. The apertures in each plate are thus simultaneously brought in front of the lens, and the exposure rapidly effected. The exposure commences and terminates at the lower side of the center, *E*, of the lens, so that the foreground will get slightly more light than the upper portion of the picture, an advantage which will be readily appreciated by photographers.

Fig. 883.



Duplex Drop Shutter.

D is a ring adapter fitted to the mount of the lens. *G* is a trigger with cord attached, fitting into notches *H*. When the exposure is completed the stop at *I* comes in contact with an overhanging hook near the trigger *G*.

Drop Tube. A PIPETTE. See DROPPER; DOSIMETER.

Drum. (*Add.*) (*Surgical.*) A circular frame over which a membrane is stretched as an object on which are tested the delicate edges of eye instruments.

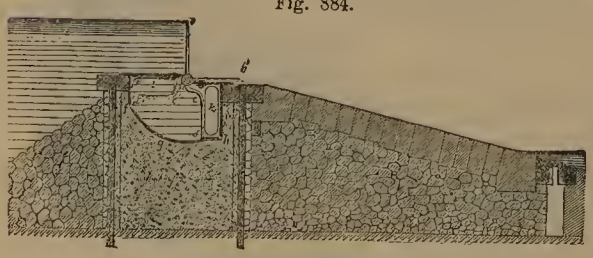
See Fig. 35 *b*, Part II., *Tiemann's "Armam. Chirurgicum."*

Drum Bar'rage. (*Hydraulic Engineering.*) The invention of *M. Desfontaine*, late chief engineer of the navigation of the Marne.

"The drum barrage consists of a system of *hausses* of a height a little more than double the difference of level in the upper and lower bays, and movable around an axle, *a*, placed in the middle. They are curved below the axle and have the form *a b c*. The axle is fixed to the upper lip of a cast-iron box. This box is partly open to allow the motion of the *hausse*, and has the contour *a e f g h*, with a curved portion from *f* to *d*, which stops at *d*, thus allowing the *hausse* to move from the position *b a c d* to the position *b' a' c' d'*, leaving the two orifices *l* and *k*, outside of its path. The upper part of the box is flat, one portion below the other, so that the *hausse*, when lowered into the position *a b'*, is a little below the level *a e*, and thus hidden by it.

"Each *hausse* is fitted to a special box or drum, but all

Fig. 884.



Desfontaine's Drum Barrage.

the boxes are pierced with oblong holes, *l* and *k*, so that they communicate when arranged side by side. The drums are fitted together by flanges around these holes, thus affording a communication along the whole line of the *barrage*, both before and behind the *hausses*, with the water in the upper bay.

"It is now evident that if, by means of sluice-gates or valves, the tube *l* is put in communication with the upper bay and the tube *k* with the lower bay, the difference of pressure on the face of the *hausse* will cause it to rise and take the position *b a c d*. If, on the other hand, the tube *k* is by a second system of sluice-gates put in communication with the upper bay and *l* with the lower bay, the system is reversed and the pressure forces the *hausse* to take the position *b' a' c' d'*; *i. e.*, lowers the *hausse*.

The simple turning of a valve thus opens the whole *barrage*. The time for opening is one and a half minutes; the time for closing four and a half minutes." — *Prof. Watson*, in "*Vienna Exposition Reports.*"

See also "*Van Nostrand's Engineering Mag.*," * xvii. 253.

Drum Guard. (*Agric.*) A British invention, to prevent a man while feeding a threshing machine from falling into the throat, and being mutilated by the cylinder. In the British practice the feeder is on top of the machine. Fig. 6395, p. 2557, "*Mech. Dict.*" In the American practice, no such attachment is used.

Clayton & Shuttleworth, Br.	* "*Engineer*," xlix. 235.
	* "*Engineering*," xxviii. 477.
Fison, Br.	* "*Engineering*," xxviii. 36.
Hunt	* "*Engineering*," xlviii. 81, 100.
Fison	
Ruston & Proctor	
Gibbon	
Robey	
Marshall, Br.	* "*Engineer*," xxvii 580.
Nalder, Br.	* "*Engineer*," xlvi. 424.
Ransome, Br.	
Robey, Br.	* "*Engineering*," xxvi. 471.
Ruston & Proctor, Br.	* "*Engineering*," xxviii. 446.
Wallis & Stevens, Br.	* "*Engineering*," xxvi 27.

Drum Weir. The drum barrage of M. Desfontaine. See DRUM BARRAGE.

Dry Cup'ping Ap'pa-ra'tus. (*Surgical.*) An apparatus in which a limb is placed while the pressure of the surrounding air is withdrawn.

For *Junod's* apparatus see ARM; BOOT. See also DEPURATOR, "*Mech. Dict.*," and AËROTHERAPY APPARATUS, *supra*.

Dry Dock. (*Hydraulic Engineering.*) A basin, structure, caisson, etc., in or by which a vessel is exposed clear of the water, for examination, cleaning, or repairs.

See list on p. 715, "*Mech. Dict.*," and DEPOSITING DOCK, *supra*. Also GRAVING DOCK, FLOATING DOCK, "*Mech. Dict.*," *et infra*.

Dry E-lec'tric Pile. A name applied to a hermetically sealed pile; not that there is no exciting liquid, but it is inclosed in insulated and air and water-tight envelope.

C. L. Van Tenac, Paris, * "*Scientific Amer. Sup.*," 913.

Dry'er. One form of dryer is that operating by centrifugal action in a wire cage, and is largely used with sugar, wringing clothes, etc. It has various names: *centrifugal machine, centrifugal filter, hydro-extractor, or sugar dryer, wringer*, etc., under some or all of which heads it is noticed in the "*Mech. Dict.*" See the various heads *supra et infra*.

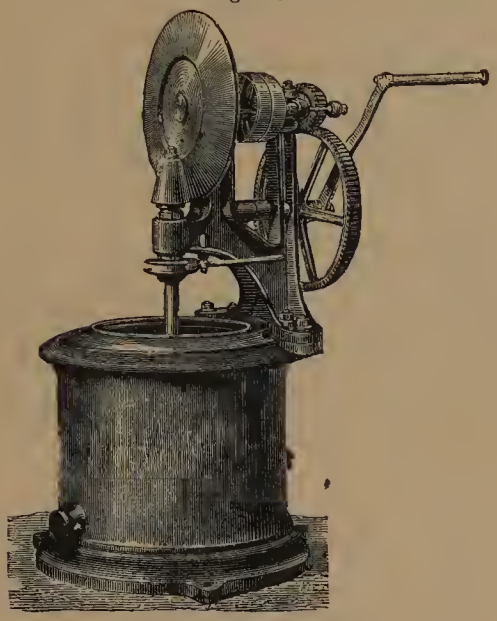
Fig. 883 shows a drying machine of a size to be driven by hand, and such as is used in French laundries. See also list of DRYERS, page 758, "*Mech. Dict.*"

Dry'ing Ap'pa-ra'tus. See the following:—

Centrifugal, *Stevenson*, Br.	* "*Engineer*," xlix. 323.
Crystals, for,	* "*Sc. American Sup.*," 1216.
Fabrics, for, *Butterworth*,	* "*Sc. American*," xli. 162.
Gunpowder stove	* "*Engineering*," xxv. 198.
Hot air, *Redfern*, Br.	* "*Sc. American Sup.*," 1014.
Oven, *Rohrbeck*	* "*Sc. American*," xlii. 180.

Dry'ing Case. (*Optics.*) A copper case surrounded with a chamber containing hot water, for drying tissues and hardening balsam preparations for the microscope.

Fig. 885.

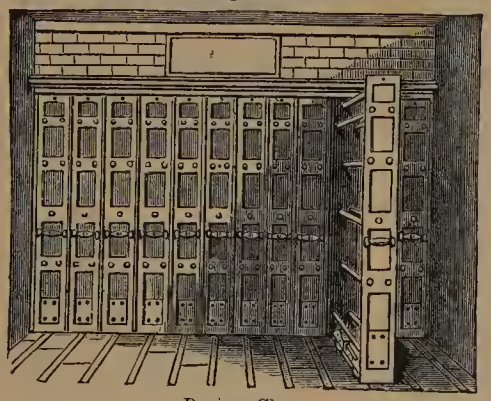


French Laundry Dryer.

Dry'ing Cham'ber. The closet in which printed stuffs are artificially dried; the tissue, accompanied by its *doublier*, passes in a zigzag manner over a large series of rollers near the ceiling and floor respectively of the room. After a certain course the *doublier* parts and goes to its own roller, while the tissue proceeds to the folding-room.

Dry'ing Clos'et. An apartment made up of

Fig. 886.



Drying Closet.

a series of "draw-out horses" for the suspension of clothes to dry. It is heated in any suitable way, and is used in asylums and public laundries.

Dry'ing House. 1. (*Powder Making.*) A building remote from those in which the mechanical operations of powder-making are carried forward, and heated by steam from a distant boiler-house.

The steam pipes are laid along the floor, and have expansion joints. The temperature by thermometer is visible through a pane of glass, and the ventilators operable from the exterior. Wooden racks hold trays of sheet copper, or wooden frames with canvas bottoms to contain the powder. The maximum temperature is 130° F., and the time employed 18 hours, with an additional 6 hours for cooling. Pebble powder requires 135° F., and 36 hours exposure.

Russian dry house, Fig. 22, accompanying appendix to "*Ordnance Report*," 1877.

2. (*Fruit.*) A structure, usually a tall wooden one-story out-house in which trays of fruit are exposed in an ascending column of heated air. See FRUIT DRYER.

Dry'ing Ma-chine'. (*Add.*) 2. The centrifugal machine is also used for drying fabrics, sugar, and other material. See DRYER.

3. A machine used in England for drying calicoes and printed cloths, consists of a furnace heating a column of air in a flat or slightly inclined trunk, through which the cloth passes on an endless apron. See Fig. 2262, article "*Lechoir*," *Laboulaye's "Dictionnaire des Arts et Manufactures,"* tome iii. The French machine, article "*Impression sur Étoffes*," Figs. 45, 46, *Ibid.*, tome ii.

Dry'ing Room. 1. (*Ceramics.*) The room in which green ware is dried previous to baking or burning, as the case may be. Some wares are baked to the biscuit condition, then ornamented and glazed; subsequently burned.

2. (*Linen.*) See DRYING CLOSET.

3. (*Calicoes.*) See DRYING MACHINE.

Dry'ing Stove. 1. (*Gunpowder.*) A close chamber in which powder is dried. A *drying house*, which see.

See also "*Ordnance Report*," 1879, pp. 108, 109; and Plate V., Fig. 10.

Drying stove, for testing samples, *Ibid.*, Plate X. *b*.

2. (*Founding.*) A large fire-proof room usually heated by an open fire, used for drying cores, dry sand, and loam molds. It is furnished with racks and shelves inside, and is usually provided with a flat carriage traveling on rails extending to the crane, and has large iron doors.

Dry Pile. (*Electricity.*) A voltaic battery in which the positive and negative plates are disposed alternately with an intervening fibrous disk, combined with a deliquescent salt.

Zamboni's Ganot's "Physics," 693, N. Y., 1877.
Prescott's "*Electricity*," 1879, p 83.
For the ordinary voltaic pile, Ganot, * 682.
Prescott's "*Electricity*," * 42; N. Y. 1879.
Dissertation, Niaudet's "*Electric Batteries*," pp. 235-237, American translation.
"*Scientific American Supplement*," * 2489.

Dry Screen. (*Mining.*) A machine in which crushed dry mineral is sifted into sizes in order to treat it farther by processes which tend to separate different qualities by differences in speed, centrifugal or otherwise, principally due to differences in specific gravity.

Revolving dry screen . "*Min. & Sc. Press*," * xxxiv. 33.

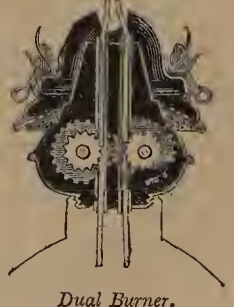
Dry Wash'er. A machine for sorting minerals by means of agitation, impulse, or air-blast, without the use of water, and so arranged that metals — gold or tin especially — are selected from the gravel, etc., by virtue of their greater specific gravity.

There are many devices which come under this definition. *Krom's* ore concentrator, for instance, Plate XXXIV., p. 1567, "*Mech. Dict.*," and Figs. 3415, 3416, *Ibid.* Also ORE SEPARATOR, p. 157, and Figs. 3421, 3422, *Ibid.*

Du'al Burn'er. A lamp burner with two wicks: flat or argand.

Du'al Tel'e-phone. Invented by Pritchett. One end of a hinged and covered magnetized bar is fitted with a padded receiving ear-piece, and its other end is fitted with a transmitting mouth-piece. It is held by one hand, and adjusted to the ear and mouth by one motion; obviating the use of two instruments.

Fig. 887.



Dual Burner.

* "*Telegraphic Journal*". vi. 471.

Dub'bing. (*Leather.*) *Daubing.* A mixture of tal-

low and either neats-foot or sperm oil. The dampened leather is coated therewith and rendered supple thereby. *Stuffing.*

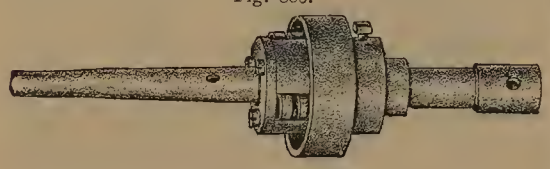
Duck'ing Boat. A low-sided boat with a well in the center for the fowler, and sharp at both ends, so as to be readily paddled either end forward. *A double-ender.*

A cedar duck boat of some celebrity, "Central Republic," is 12′ long, 3′ 11″ beam, depth 12″. This boat was navigated by Mr. Bishop, of Lake George, from Pittsburg, Pa., via the Ohio and Mississippi Rivers and Gulf of Mexico to Cedar Keys, Florida, during 1875, 1876.

Duck's'-foot Cul'ti-va'tor. A cultivator with wide flanged shares, resembling the splayed foot of a duck. Such a cultivator has usually an expanding frame held to the width desired by perforated connecting rods and set screws. See shape of hoes in Fig. 2521, *b*, p. 1107, "*Mech. Dict.*"

Dudg'eon Ex-pand'er. (*Plumbing.*) A tool

Fig. 888.



Dudgeon Expander.

for expanding leaden packing into the internal flange recesses of pipe connections.

Dum'my. *Add.* 4. (*Print.*) A blank book in which copy and cuts are pasted in the way desired for the make-up of a book to be printed.

5. A card on which a number of cuts or views are arranged to be copied as a group, photographically or otherwise.

6. (*Binding.*) A book made up with leaves of a given number and size and weight of paper, and bound in such a style as to represent the finished book in external appearance and size.

Dump Car. See reference, p. 761, * "*Mech. Dict.*"; also, —

Car, New England Car Co.	* "*Sc. Am.*," xlii. 306.
Car, Screw lever, *Van Wormer*	* "*R. R. Gaz.*," xxiv. 695.
Cart, *Wiestling*	* "*Sc. Am.*," xxxii. 111.
Scow, *Allen*	* "*Sc. Am.*," xxxvi. 166.

Dump'ing Bar'row. A barrow arranged to upset its load. Used especially in furnaces. See CHARGING BARROW.

Fig. 889.

French Dumping Bucket.

French dumping barrows, Figs. 8, 9, p. 322, * "*Scientific American*," xxxix.

Dump'ing Buck'et. A suspended bucket, discharging by flap bottom when a latch is withdrawn.

Willis & Rowe.
* "*Scientific American*," xxxvi. 4.

Dump'ing Grate. A tipping grate in a stove or heater.

Dump'y Bit. (*Manége.*) A curb bit having the length of the lower arm of the cheek piece so reduced that it is but a trifle larger than the upper arm.

Dump'y Lev'el. A surveyor's level with a short telescope of large aperture.

Dancer, Br.	* "*Engineering*," xxvi. 140.

Du'plex Air Com-pres'sor. See AIR COMPRESSOR, Plate I., p. 14.

Du'plex Bor'ing and Fa'cing Ma-chine'. A tool intended for such work as boring out both ends of a coupling rod at once, or boring two cylinders at the same time, or facing two valve seats on the same piece simultaneously.

Bede et Cie., Verviers, Belgium	"*Engineer*," * xli. 5.

Du'plex Bor'ing, Turn'ing, and Groov'ing Ma-chine'. A machine having the characteristics of a double-ended gap-lathe, with two face plates and tail stocks and separate driving gear; also a hollow head spindle, which admits of the passage of a car axle so as to present the ends of the axle or the wheels thereon for simultaneous action by the various tools for turning, boring, or key-way grooving.

Atock	"*Engineering*," * xxi. 310.

Du'plex Ma-chine'. One capable of performing similar operations upon two pieces of work simultaneously. Instances are given under two heads; *supra et infra.*

Du'plex Plan'ing Ma-chine'. One having duplicated parts capable of acting upon two faces of the same piece, or two pieces independently, etc. The adjustments are according to construction and purpose. Adamson's is furnished with two tables, each provided with independent driving gear, the arrangement being such that the tables may be worked either together or separately. The machine can thus be used as one large planing machine with independently set cutters operating on two faces, or as two smaller independent machines. Or a piece may be bolted to one, and operated by a tool carrier on the other.

"*Engineering*"	* xxi. 291, 294.

Du'plex Slide Rest. A lathe with a tool-rest on either side of the object being turned. See DUPLEX LATHE, Fig. 1803, p. 763, "*Mech. Dict.*"

Du'plex Tel'e-graph. An instrument for sending two messages over the same wire simultaneously. See p. 764, * "*Mech. Dict.*"

Aillhaud, Fr.	* "*Engineering*," xxiv. 74.
	* "*Jour. Soc. Tel. Eng.*," vi. 205.
Banker	* "*Scientific Am. Sup.*," 2737.
	* "*Telegraphic Jour.*," vii. 82.
Berstein Multiplex	Br. Patent, 2,575 of 1855.
Dennett, Translator	* "*Telegraphic Jour.*," vi. 292.
d'Infreville	* "*Telegraphic Jour.*," iv. 23.
Electro-mechanical	* "*Scientific Amer. Sup.*," 80.
Fahie, Paper by	* "*Jour. Soc. Tel. Eng.*," v. 473.
Haskins	* "*Telegraphic Jour.*," iv. 45.
Koch	* "*Telegraphic Jour.*," iv. 290.
Lines, history of early	* "*Rept. Vienna Exp.*," 1873.
Morel	"*Eng. & Min. J.*," xxvi. 166.
Muirhead	* "*Teleg. Jour.*," vii. 160, 177.
Schwendler, on Theory of	"*Jour. Soc. Tel. Eng.*," vi. 360; * 534; vii. 104.
Sieur, Fr.	* "*Engineering*," xxvii. 169.
Stearns (submarine)	* *Lines* "*Rept. Vienna Exp.*," 1873.
	* "*Telegraphic Jour.*," vii. 163.
Theiler	* "*Telegraphic Jour.*," vii. 227.
Treatise on	* "*Engineering*," xxix. 448.
	"*Scientific Amer. Sup.*," 1053.
Vianisi	* "*Jour. Soc. Tel. Eng.*," viii. 149.

Du'plex Wheel Lathe. (*Machine Tools.*) A double wheel lathe. See WHEEL LATHE, Fig. 7183, p. 2767, "*Mech. Dict.*"

Dust Col'lar. (*Railway.*) A ring or flange around an axle to keep dust from entering the axle box. See AXLE BOX.

Dust Col-lect'or. A device in flouring mills or factories to collect the dust which furnishes the material for explosion or is injurious to the health of the operatives.

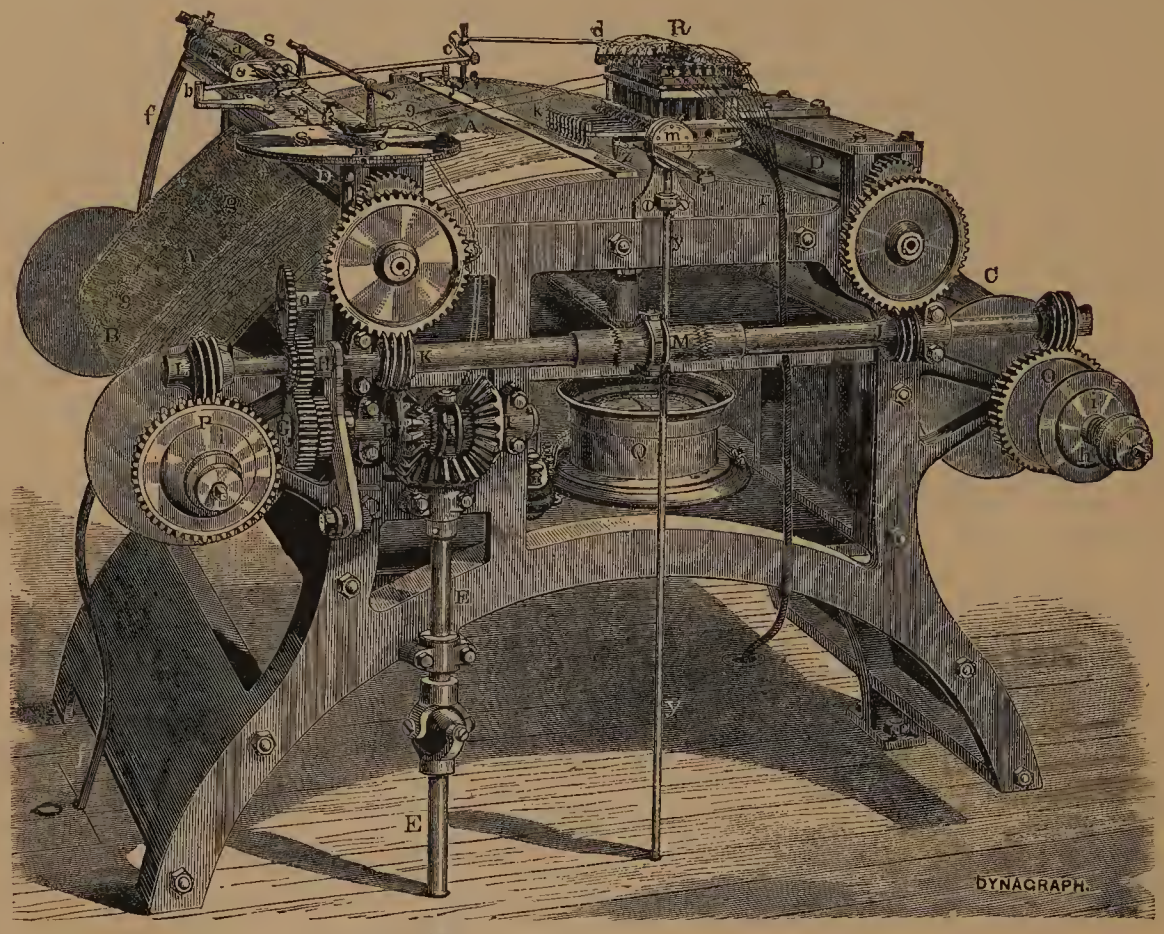
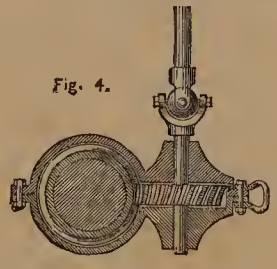


Fig. 4.



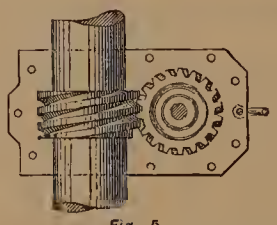


Fig. 5.

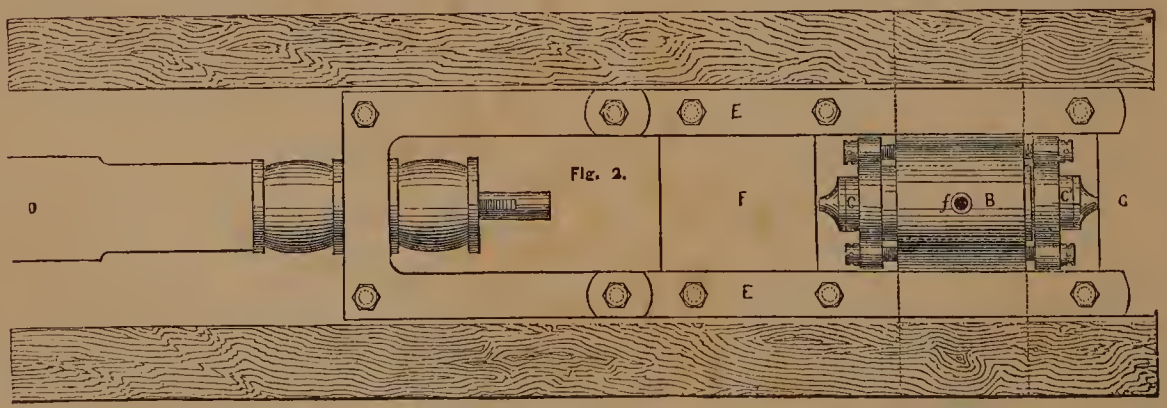


Fig. 2.

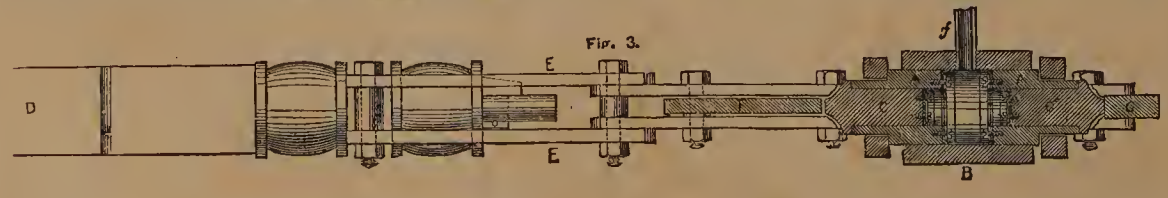


Fig. 3.

Blower, *Norcross, Stover* . * } "*Manuf. & Builder*," xi. 150.
Fairbanks . . . . }
Conductor, *Stover* . . . * }
Fairbanks . . . . * } "*Manuf. & Builder*," ix. 126.
Sturtevant . . . . * }
Flour mills, *Smith* . . . * "*American Miller*," vii. 311.

Dust'er. (*Add.*) 3. A machine for sifting dry poisons upon plants to destroy insects.

Allen's duster for destroying cotton worm, "*Comstock's Report on Cotton Insects*," 1879, * p. 247.
See also COTTON-WORM DESTROYER, p. 226, *supra*.

4. A dusting brush. Feather brushes and tails of animals were anciently used.

Dust Guard. A device to prevent dust from entering the journal box of a car-axle, and the oil from escaping thence. See p. 459, "*Mech. Dict.*"

Balch & Heintzelman, * "*Railroad Gazette*," viii., p. 307.

Dust'ing Ma-chine'. A machine for removing the dust from crude granulated gunpowder.

"*Ordnance Report*," 1879, Appendix, I., Plate IV., Fig. 9. and description on pp. 106, 107.
Dusting reel, Br. . . . . * "*Engineering*," xxv. 133.

Dy'na-graph. (*Railway.*) A machine for recording the phenomena occurring to a train in traveling upon a railway track.

Pambour, in his book on Locomotive Engines (edition of 1836, p. 83), discusses the question of determining the friction and resistance of railway rolling stock, and details the difficulties which accompanied the attempts to solve the problem. The interposition of a dynamometer between the engine and the car or cars was the means applied.

The apparatus of Prof. P. H. Dudley is placed in a car and uses 14 recording pens which make diagrams of the various phenomena.

The dynagraph track inspection record is traced on a continuous roll of profile paper wound in a length of 150′ upon a drum. The paper has various groups of rulings and the tracings are made by glass tube-pens filled with *eozine*.

The following diagram gives the nature and order of the indications on the record, — the broad paper ribbon which is shown in Plate X., as passing beneath the pens and wound upon a roller at the left of the machine.

The places of the tracings and explanations are shown in the column, which is not a *fac-simile* but merely an explanatory statement in columnar form.

NORTH TRACK.

Surfaces of rails and low joints.
- North rail.
- (*Tracing.*)
- Horizontal scale 50′ to 1″ of paper.
- Vertical scale full size.
- (*Tracing.*)
- South rail.

Gage of track.
- North rail.
- (*Tracing.*)
- Alignment of joints
- (*Tracing.*)
- South rail.

Distance by instrument.

Mile posts and stations.

Oscillations of car. (*Tracing.*)

10 seconds.

Seconds.

(*Tracing.*) Representing elevation of rail on curves.

The machine as represented in Fig. 1, Plate X., is placed in an eight-wheeled car, 50′ long, constructed especially for the purpose. The draw-bar of this car is connected with a piston which works in a cylinder under the floor, and which is filled with oil. (Figs. 2, 3.) These are so arranged that if the draw-bar is subjected to strains of either tension or compression they are resisted by the oil in the cylinder, and the former is therefore subject to the pressure due to the strains on the draw-bar or the resistance of the train. The cylinder is connected by a pipe, *f*, Figs. 1, 2, and 3, with a smaller cylinder *a*, 7-16″ in diameter at the top of the machine. This has a piston fitted into it which is connected by a rod with the parallel motion *b c d*. This latter carries a pen, *e*, which draws a diagram of the resistance of the train on a roll of paper, *A A*, 30″ wide. Part of the diagram drawn by this pen is shown at *g g*. The roll of paper is placed in the drum *C*, and is drawn over the table *A A* by feed-rolls, *D D*, and is wound up on the drum *B*. These drums and rolls are driven by a worm-gear on the axle, shown in Figs. 4 and 5, which operates the vertical shaft *E E*, Fig. 1. The worm-gear, being on the axle, is underneath the floor of the car, and is not shown in Fig. 1. The shaft *E* has a miter-wheel at the upper end which gears into a pair of miters, *F F*, which are loose on a horizontal shaft, *G F*.

A clutch collar *N* is attached to the shaft by a feather and is arranged so that it can engage with either of the miter wheels, so that the machine can be used in running in either direction. The shaft *G F* has a pinion on it, not shown in the engraving, behind the pair of change gear wheels *G*. This pinion engages with one of the wheels *G* and that with the wheel *H* on the horizontal shaft *L I*. On this shaft are four worms, *L*, *K*, *J*, and *I*. *I* and *L* are keyed to the shaft, but *J* and *K* are attached to sleeves which are loose on the outside of the shaft. Either *J* or *K* can be driven by the clutch *M*, which is attached to the shaft by a feather. The worms *I* and *L* drive the worm-wheels *O* and *P*, which are connected to the shafts of the drums by the friction produced by springs (one of them shown at *h*) against disks, *i*, *i*, the purpose of the drums being simply to wind and unwind the paper, and keep it taut: which is effected by the friction arrangement. The paper is fed over the table uniformly for the distance traveled by either pair of the feed-rollers *D* or *D′*. Only one of each pair of these rollers is shown, the other being below the surface of the table. These rollers are 2.472″ in diameter, and are made of steel and ground with the utmost precision, so as to be 0.003″ larger in diameter in the center than at the ends, the object of this being to draw the paper through evenly. If the rolls were made perfectly straight they would be liable to seize the paper on one side more than on the other. The paper can be wound by the mechanism in either way, that is, from *C* on to *B*, or from *B* on to *C*, so that the instrument can be used while running the car in either direction.

As stated before, the pen *e* draws a diagram of the resistance of the train. A stationary pen, *j*, draws a straight base line on the paper as it is rolled across the table. When there is no tension or compression on the draw-bar and cylinder underneath the car, and consequently no pressure on the fluid in the cylinder *a*, its piston is drawn back by the springs *s s* and with it the lever *b c*, so that the position of the pen *e* corresponds with that of *j* and the base line which the latter draws. So soon as there is any pressure in the cylinder *a* its piston is forced outward against the tension of the springs *s s*, and consequently the pen *e* is carried away from the base-line a distance proportional to the pressure, and the diagram thus indicates the tension on the draw-bar.

The speed of the train is recorded by means of an electrical attachment with the chronometer clock *Q*. This is arranged so as to break an electrical circuit every second, which releases an armature of an electro-magnet at *R*, with which one of the pens, shown at *k*, is connected. This moves the pen 1-16″ horizontally, which produces an indentation in the line which is drawn on the paper. The distance between these indentations indicates the space traveled over in one second. The next pencil to *k* is arranged so as to make a similar record every ten seconds. Still another pen can be used to record minutes.

A pen is also arranged so that by an electrical connection it records each revolution of the driving-wheels. Another records the mile-posts as they are passed, which is done by an assistant, who touches an electrical key at each post. The alignment of the road, that is, the curves and straight lines, are recorded by a pen in a similar way. A pen next to this is connected with a water-meter attached to the feed-pipe of the locomotive, and records the quantity of water consumed at different times and places. Still another pen is arranged so that an assistant on the locomotive records every shovelful of coal as it is put on the fire. The same pen has been used to record the time that black smoke escaped from the chimney. A pen is also provided which records the distance run by the car, and another records the indications of an anemometer on top of the car. At *z* is the fourteenth pen, which records the surface of the track. This is done by a small vessel or cylinder about 3″ in diameter, which is attached to the equalizing lever immediately over the journal-

box. This vessel is filled with oil and covered with a thin metallic diaphragm, which is pressed down by a spiral spring. The chamber containing the oil is connected by a pipe with a gage, *m*, which also has a similar diaphragm which acts against a compound lever carrying the pencil *z*. The jolting of the car over inequalities of the track produces pulsations in the diaphragm over the journal-box, and consequently more or less pressure on the liquid, which pressure is communicated to the upper diaphragm at *m*, and thus recorded by the pen *z*.

An integrating apparatus is also attached to the instrument at *S*. This consists of a plate, *S*, which is attached to the end of a vertical shaft driven by the gear-wheel *O* and a worm, not shown in the engraving. The speeds are so arranged that the plate makes three revolutions per mile run by the car. A small wheel, *n*, which is attached to a rod, *q*, connected with the piston in the cylinder *a*, bears on the plate *S*. When there is no pressure in the cylinder, the small wheel *n* is exactly in the center of *S*, and consequently the revolution of *S* does not cause the wheel *n* to revolve. When the piston is forced out by the pressure, the small wheel is carried beyond the center of the plate *S*, and consequently the movement of the latter then causes the small wheel to revolve. Of course the greater the pressure in the cylinder *a* the farther will the wheel *n* be carried from the center of *S* and the greater will be the path on which it rolls, and consequently the larger the number of its revolutions. At each revolution of the wheel it breaks an electrical circuit, and connecting by a wire with one of the electro-magnets at *R* operates a lever which carries one of the pens shown at *k*. It is obvious from this that the greater the pressure on the cylinder *a* the larger the number of revolutions which will be made by the small wheel *n*, and therefore that they will be a measure of the work done; so that multiplying the number of revolutions by a known constant will give the number of foot-pounds.

The disk *S* is graduated on the edge, and has a vernier attachment with which very minute measurements can be made of the distance run.

The battery jars for working the electrical apparatus are carried underneath the car in a locker, and are connected with the magnets by the wires shown at *r*.

The pens consist of small glass tubes, which are drawn to a fine point and filled with eozine, one of the products of coal-tar distillation. A half grain of this is dissolved in an ounce of water, and makes a beautiful red color.

The draw-bar cylinder *B* is shown in plan in Fig. 2, and in section in Fig. 3, and is 4″ in diameter, and has a pair of large pistons, *A A*, which fit into it at each end. Into these an auxiliary pair of pistons, *C C*, are fitted. These are used in making experiments with light loads. The packing is of the ordinary kind used in hydraulic rams. *D* is the draw-bar which is connected with the pistons by a frame, *E E*. In drawing a train the cross-bar *G* presses against the piston *C*, and in pushing the bar *F* presses against *C*, so that in either case the strain on the draw-bar produces a corresponding pressure on the liquid (oil) in the cylinder. The pipe *L* connects the main cylinder *B* with the smaller cylinder *a*, Fig. 1, on the dynagraph above, the working of which has already been described.

Figs. 4 and 5 represent the worm gear on the axle by which motion is transmitted to the mechanism above through the shaft.

See account of Bavarian experiments by Baron M. M. Von Weber, "*Transactions of Am. Soc. C. E.*," February, 1879, and reference to same in "*Railroad Gazette*," *xxiv. 375.

See also the following references to dynagraph cars: —

E. Ry. of France . . . "*Engineering*," *xxvi. 290, *307, *330.
Dudley . . . "*Eng. & Min. Jour.*," xxii. 37.
"*American R. R. Jour.*," liii. 619.
"*Scientific Amer. Sup.*," 131, 1145.
"*Scientific Amer.*," xxxvii. 264.
"*Railroad Gazette*," xx. 317.
* "*Railroad Gazette*," xxiii. 494.
Brake car for tests.
Westinghouse . . "*Engineer*," xliii. 380.
* "*Engineer*," xliii. 402.
* "*Engineering*," xxv. 470.

In connection with this subject the following references will be useful, — the number of United States patent, the name of the inventor, and the subject matter of the patent being given: —

SPEED, COURSE, GRADE, AND DISTANCE RECORDERS.

No.	Inventor.	Subject.
16,902	*Adams & Clark*,	Grade deliueator.
27,764	*Billings*,	Speed register.
32,959	*Bogardus*,	Grade recorder.
30,528	*Collier*,	River course delineator.
155,605	*Crawley*,	Velocimeter.
205,844	*Dorpmüller*,	Speed recorder.
196,643	*Dunlap & Magill*,	Speed and distance recorder.
202,433	*Gobel*,	Distance and velocity recorder.
231,799	*Hergenroder*,	Surveyor and plotter.
179,200	*Kettell*,	Station indicator and speed recorder.
36,411	*Krausch*,	Engine recorder.
222,293	*Luders*,	Shock recorder.
183,479	*Manger*,	Recording surveyor.
15,017	*Peverley*,	Ship recording-compass.
229,456	*Petri*,	Speed indicator and recorder.
147,021	*Rankin*,	Ship's course recorder.
138,437	*Richardson*,	Locomotive recorder.
219.527	*Richardson*,	Speed and time recorder.
47,906	*Schön*,	Recording surveyor.
118,160	*Sheltman*,	Speed recorder.
176,584	*Simonds*,	Time and distance recorder.
37,650	*Van Horn*,	Profiler. River bed.
20,908	*Wampler*,	Graphodometer.
153,470	*Wythe*,	Railway speed recorder.
173,251	*Wythe*,	Railway speed recorder.
198,232	*Wythe*,	Railway speed recorder. (Pencil carrier.)
203,865	*Wythe*,	Railway speed recorder.

See also English patents: —

2,692 of 1855.	581 of 1867.
2,141 of 1860.	890 of 1858.
11,619 of 1847.	8,645 of 1840.
2,892 of 1856.	1,673 of 1857.
1,407 of 1863.	2,285 of 1863.

See also United States Patents: —

Lewis, 1867, Velocimeter.
Horn, 1868, Mileage register.
Guebhard & Tronchon, 1873, Cab register.
Keeler, 1864, Speed indicator.
Bowsher, 1868, Speed indicator.
Bilgram, 1871, Speed indicator.
Speed & Poage, 1874, Speed indicator.
Liernur, 1858, Speed recorder.
Bewckert, 1857, Speed indicator.
Brown, 1874, Revolution indicator.
Elliott, 1874, Tachometer.

See also Figs. 5366, 5367, 5372, 5373, 5374, and pp. 2261–2264, "*Mech. Dict.*"

See also under the following heads in this and former volumes: —

Delineator.	Log.
Grade recorder.	Odometer.
Sounding instruments.	Surveying instruments.

See also specific indexes, METERS, p. 1427, "*Mech. Dict.*;" MEASURING and RECORDING INSTRUMENTS, *infra*.

Dy-nam'ic E'lec-tric'i-ty. Electricity in a state of action. The opposite of *static*.

Dy'nam-ite. A mixture of nitro-glycerine and infusorial silica. See p. 767, "*Mech. Dict.*"

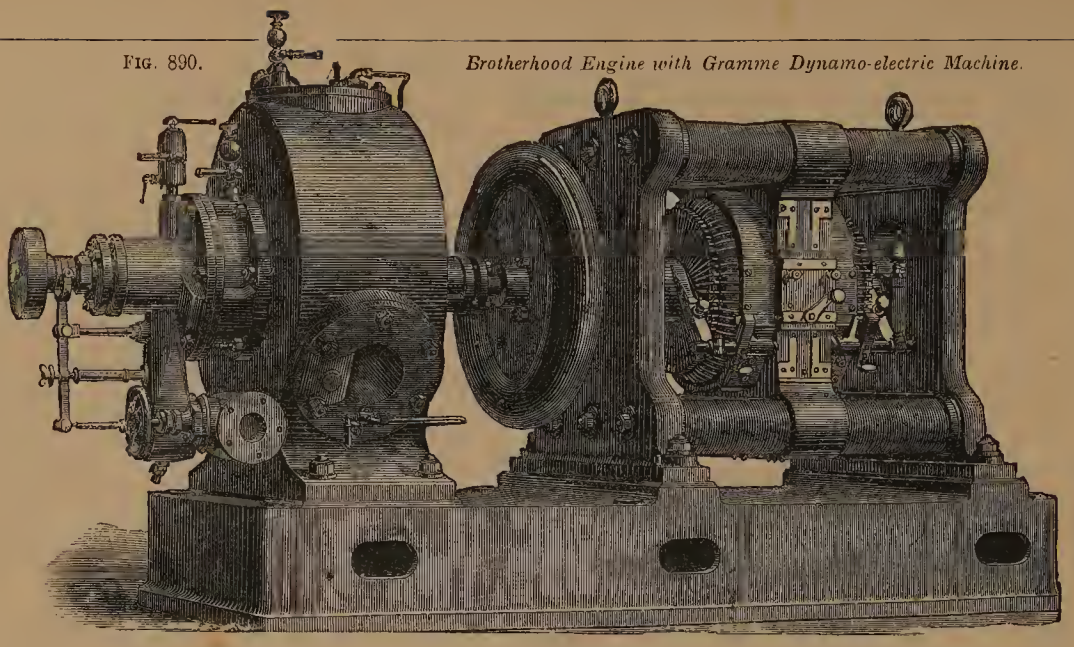
See also the following references: —

Roux . . . . . "*Iron Age*," xvii., May 18, p. 7.
Apparatus . . . . . * "*Engineer*," xli. 171.
In agriculture . . . . "*Scientific American Sup.*," 2136.
"*Scientific American*," xxxv. 242
In Germany . . . . "*Technologiste*," xxxviii. 17.
In plowing . . . . "*Iron Age*," xviii., Nov. 2, p. 11.
In clearing . . . . "*Iron Age*," xviii., Nov. 30, p. 1.
Nobel . . . . "*Technologiste*," xli. 94.
Manufacture . . "*Scientific American*," xlii. 276.
* "*Scientific American*," xxxiv. 83.
"*Scientific Amer.*," xxxviii. 58.
"*Scientific American Sup.*," 692.
Sobrero . . . . . "*Technologiste*," xxxvii. 161.
"*Van Nostrand's Mag.*," xv. 480.
Pile driving.
Paper by *Lockert* . . "*Technologiste*," xl. 37.

Dy-na'mo-e-lec'tric En'gine. A steam-engine adapted for driving a dynamo-electric machine. While many forms of steam-engine have been used for this purpose, the direct acting has some more peculiar features of compactness and special adaptation.

Fig. 890, Plate XI., shows the adaptation of the *Brotherhood* three-cylinder engine to driving a *Gramme* machine. The engine consists of three steam cylinders arranged radially around a framing at equal angular distances apart, their axes converging in a point; within the central space around this point revolves a crank axle, which is kept in rotation by the successive impulses of the three pistons which are connected to its crank-pin by connecting rods, the heads of which are provided with brasses bearing against it; and a circular distributing valve revolving with the shaft regulates the admission of steam to each cylinder in succession and determines the position of the cut-off, and, therefore, the period during which each cylinder is being worked by the expansive force of its imprisoned steam.

FIG. 890. *Brotherhood Engine with Gramme Dynamo-electric Machine.*



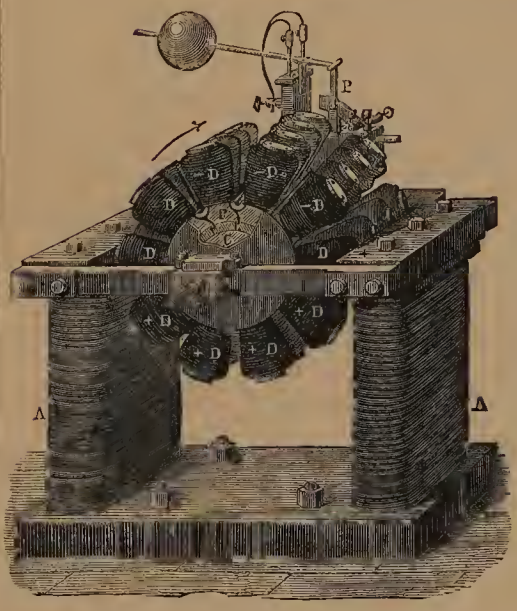


FIG. 892. *Lontin Dynamo-electric Machine.*

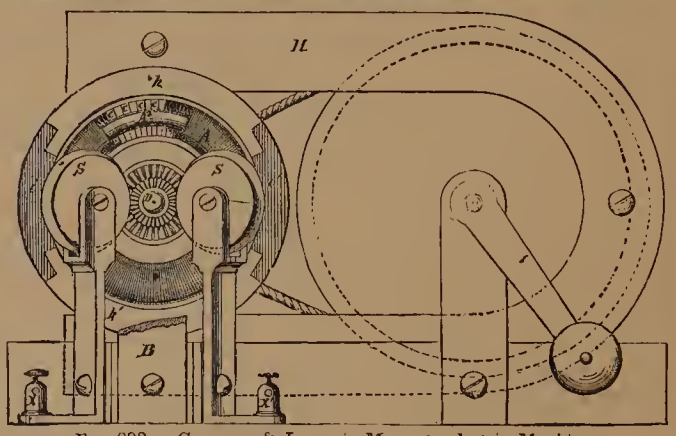
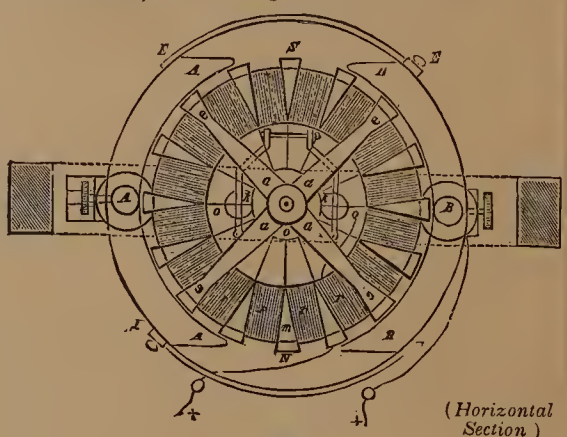


FIG. 893. *Gramme & Ivernois Magneto-electric Machine.*



(Horizontal Section)

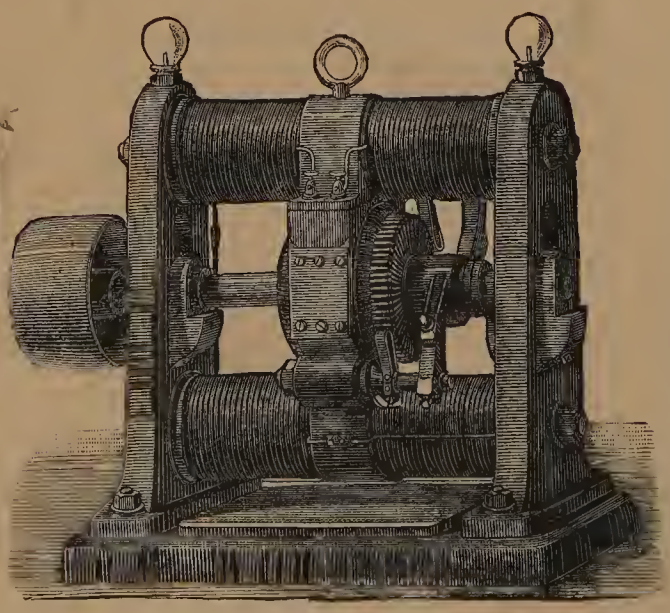
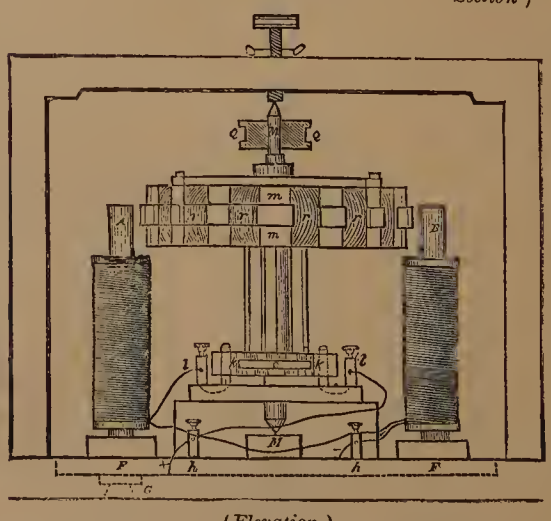


FIG. 894. *Gramme Electric Light Machine.*



(Elevation.)

FIG. 891. *Pacinotti Magneto-electric Machine.*

The shaft and armature spindle lie in the same line and are coupled direct to one another, thus avoiding the use of belting or gearing. The apparatus represented was constructed for the British government for torpedo work, the current being utilized in a *Serrin* lamp. The machine absorbs 13 horse-power, running at 500 revolutions per minute, when it produces a light of 43,000 normal sperm candles.

The consumption of steam, which is worked at 80 lbs. to the square inch, is 41.1 lb. per indicated horse-power per hour. The weight of the whole apparatus is 4,256 lbs., of which the *Gramme* machine represeuts 2,240.

Dy-na'mo-e-lec'tric Ma-chine'. Speaking generally, the term dynamo-electric machine is applied to any one which produces a current of electricity, by the conversion of dynamic or mechanical energy into electric force by the movement of some of its parts in the neighborhood of others.

More definitely, "An electro-voltaic generator whose magnetic field is derived from an *electro*-magnet, in contradistinction to a magneto-electric generator whose magnetic field is derived from a *permanent* magnet." — *Sawyer.*

In the still more modern terminology, a machine for translating motion into electricity, in which the magnetic field in which the armature rotates is formed by electro-magnets having their coils connected in a circuit with the coils of the armature and the main line, whereby upon starting the machine with a minimum of magnetism in the cores of the field magnets, an inter-reacting cumulative action takes place, the initial magnetism creating an initial current in the armature, which, flowing around the field magnets, increase their force, in turn reacting on the armature coils, and so on until the maximum current is produced when the field cores attain saturation.

The discovery of electric induction by Prof. Faraday, in the year 1831, drew the attention of the scientific world to the possibility of utilizing motive power as a meaus of generating a current of electricity.

"Faraday demonstrated before the Royal Society that if a helix of insulated wire, there is at the moment of introduction of the maguet a current of electricity set up in a certain direction in the insulated wire forming the helix, while on the withdrawal of the maguet from the helix a current in an opposite direction takes place.

"He also discovered that the same phenomenon was to be observed if for the magnet was substituted a coil of insulated wire, through which the current from a voltaic element was passing; and further, that when an insulated coil of wire was made to revolve before the poles of a permanent magnet, electric currents were induced in the wires of the coil. It is on these discoveries that are based the action of all magneto-electric machines." — "*Journal of the Society of Arts.*"

Pixii was the first to construct a magnetic machine. His machine had a revolving permanent vertical horse-shoe magnet above which was fastened an electro-maguet, and the poles of the two brought into close proximity. As the poles of the permanent passed those of the electro-magnet, a series of reversed currents were set up in the wires of the latter. A small circular commutator was placed below the horse-shoe magnet and revolved with it.

Saxton placed the permauent magnet horizontal, and the axis of the revolving electro-magnet in corresponding position. He also increased the relative size of the horse-shoe magnet.

Clarke placed the axis of the electro-magnet at the side of and at right angles to the permanent, so that its poles were made to pass those points of the latter where the greatest strength was to be obtained. A commutator placed on the spindle of the electro-magnets corrected the reversal of the currents generated.

In the Niaudet machine the current is continuous. A number of bobbins with soft iron cores are fixed parallel to an axis with which they revolve. The poles of these bobbius turn between the poles of the permanent horse-shoe magnets, one magnet being at each end of the bobbins; a sort of duplication of the Clarke machine. The bobbins are joined in series, with connection made at the point of juncture to a commutator. Two contact springs make the connections to the terminals of the machine.

The Nollet ("Alliance") machine (1850) was originally intended by its inventor for the decomposition of water, the hydrogen gas to be carbureted by passing through camphene, and used for lighting purposes. It contains a number of gun-metal disks running on a horizontal shaft, and carrying near the circumference of each disk a series of 16 bobbins with soft iron cores, arranged equidistant and parallel to the shaft, and free to turn with the disks between the poles of 8 horse-shoe permanent magnets, the poles of which are placed radially to the shaft. The faces of the magnets are parallel to the disks, so that in each circumference there are 16 poles corresponding to the 16 bobbins. The bobbins are connected in series, one end of the wire being connected to the shaft, and the other to an insulated ring upon the shaft; to these are connected the terminals.

The machine has been largely used for light-houses in France: at La Hève and Grinez, for instances.

The Holmes machine (1856) differs from the Nollet in the arrangement of the bobbins. They are held between two brass disks in two or more concentric circles, the bobbins rotating in front of the poles of a number of permanent magnets fixed on the frame, and arranged radial to the axis. This gives a quicker succession to the contacts. A commutator directs the alternating currents so as to pass off in the same direction. The South Foreland light, and afterwards the Dungeness lighthouse, were lighted by means of this machine. In later machines, the magnets are made to turn while the bobbins are fixed.

In the Siemens-Halske machine (1854) the electrical magnet was replaced by a cylindrical bar of soft iron with four longitudinal grooves × section, in which insulated wire is wound parallel to the axis, so as to form a complete cylinder. One end of the wire was soldered to the axis, and the other to an insulated ring at the extremity of the axis; these connected to the respective terminals. The poles of a permanent magnet were so formed as to embrace the cylinder without touching.

The Wheatstone machine is in general use for private wires in Great Britain, applied to the A B C telegraph. Attached to the poles of a permanent compound magnet is a set of 4 bobbins, the soft iron cores of which are fixed permanently to the magnet, two to each pole. In front of these cores is a soft iron revolving armature. The cores of the bobbius being fixed to the poles of the magnet, receive polarity from them and form 4 poles, 2 North, and 2 South. The turning armature passing in front of these poles induces currents in the bobbin wires, which by couuections actuate the needle of the telegraph instrument.

The original dynamo-electric machine, or accumulative generator, is described in the English patent of Sören Hjorth, of Copenhagen, No. 2,198, October 14, 1854. It is perhaps the most remarkable, from one point of view, of the series It describes and illustrates a "Magneto-elcctric Battery," so constructed that "the currents induced in the coils of the revolving armature are allowed to pass round the electro-magnets; consequently, the more the electro-magnets are excited in the said manner the more will the armatures be excited, and more electricity of course be induced in the respective coilings; and while a mutual and accelerating force is thus produced in this manner between the electro-magnets and the armatures, an additional or secondary current is at the same time induced in the coiling of the electro-magnets by the motion of the armatures, the said current flowing in the same direction as that of the primary current after having passed the commutator. The direction of the current induced in the coils of the armatures will of course be reversed according to the change of the respective polarities, and the commutator is therefore applied for the purpose of causing the same to flow constantly in the same direction."

The cores may be cast-iron, or steel magnets.

It would seem that the invention of Sören Hjorth and the English patent of 1854 had been entirely overlooked by the British, German, and French experts; and the claim of Dr. Siemens and Sir Charles Wheatstone to the inventiou of the accumulation generator, in 1867, was made in apparent ignorance of the claims of the Swedish inventor of 13 years previous. The latter claims are now revived, and the history of the dynamo-electric machine must be re-written: *e. g.*, the account in "*Engineering*," xxiv. 307; xxviii. 63, etc. —

"Early in 1867, an announcement was made to the Royal Society simultaneously by Dr. C. W. Siemens and Sir Charles Wheatstone, of the discovery made independently by Dr. Werner Siemens and Sir Charles, of the reaction principle of magnetization, by which a very powerful electric current may be generated through the building up of the effects of action and reaction taking place between an electro-magnet and a magneto-electric inductor revolving in its magnetic field, and included in the same circuit."

It appears that the discovery was announced by Dr. Werner Siemens to the Berlin Academy of Science a month before its announcement to the Royal Society. Mr. S. A. Varley and Mr. M. G. Farmer were also working on the same invention apparently about the same time.

The Wilde machine (1866) is one of the foundation machines, using a Siemens-Halske armature between the poles of a field electro-magnet, which is excited by a small hand magneto-electric machine. It may be compared to one small Siemens machine placed on top of another of larger

size. The current from the smaller one is used for magnetizing the two powerful electro-magnets of the larger one: the latter replacing the permanent ones ordinarily used in the Siemens.

The first machine for the production of an electric current constant in direction and intensity was the electro-magnetic ring machine of Dr. A. Pacinotti, of Pisa, Italy, 1860, and described in "*Il Nuovo Cimento*," June, 1864.

The peculiarity of the machine was the movable electro-magnet in the form of a circular iron ring in which the magnetic poles were movable, instead of remaining stationary, as in the previous machines. The machine as shown in Fig. 891, Plate XI., and the description following, have reference to its application as an electro-magnetic machine, but Pacinotti indicated, in the Italian publication referred to, a way in which, by the use of the same annular armature, the electro-magnetic may be converted into a magneto-electric machine capable of producing, by the constant use in connection with it of a permanent or electro-magnet, a continuous current of a constant direction.

"This movable ring of iron had the shape of a spur-wheel of 16 teeth, and was firmly secured to the axis of the machine by means of four strips of brass. Small wooden wedges were placed upon the teeth of the ring, and the space so formed between each two of the wedges filled up regularly with insulated copper wire. These spools were all wound in the same direction, and the terminal end of each was soldered to the beginning of the one succeeding it, so that the whole system of 16 spools virtually formed a single coil of wire surrounding the ring in a regular manner, and returning upon itself.

"Wires were soldered to the separate points of juncture and were led, parallel to the axis of rotation, to an equal number of insulated pieces of brass, mounted in two rows upon, and slightly projecting from, the surface of a disk firmly secured to the axis.

"The iron ring, with the bobbins wound upon it in the manner already described, was mounted in a horizontal position between the two legs of a powerful upright electro-magnet, the distance of which from the ring could be adjusted at pleasure by means of a set screw and a slot in the lower connecting cross-piece. Contact rollers *k k* were made to press, one on each side of the axis, against the lower wooden disk carrying the strips of brass, so that during the rotation of the ring all of the latter were brought successively into contact with them. When, therefore, the terminal posts *h h'* are placed in connection with the poles of a galvanic battery the current will pass, supposing it to enter at *h* (+), by way of the binding-post *l* to the roller *k*, and through the strip of brass on the disk against which the roller may happen to press at the time, up to the two wire coils of the armature whose point of juncture is in connection with the strip of brass.

The current here divides, each portion passing in an opposite direction through the spools surrounding each half circumference of the ring, to meet again to form one current at the left contact roller *k*, whence the reunited current passes to the second binding-post *l'*. From here the current proceeds to the leg *A* of the electro-magnet, circulates around it, and, after acting similarly with regard to the other leg, *B*, passes back by way of the binding-post *h'* to the negative pole of the battery. Magnetic poles thus became developed in the iron ring at the points *N S*, the position of the contact rollers having been so chosen as to bring about this effect, and the actions of attraction and repulsion taking place between them and the poles of the stationary electro-magnet gave rise to the rotation of the ring.

"In order to turn the action of the electro-magnet upon the magnetized iron ring to the greatest possible account, Pacinotti provided the two poles with armatures, *A A A*, *B B B*, of soft iron, which were made to surround the ring very closely for over two thirds of its circumference. Strips of brass, *E E*, *F F*, attached, served to give them greater security. In the elevation of the machine here given these armatures have been omitted in order not to conceal the ring and its surrounding spools." — *Prof. Henry Morton.*

In the Lontin machine, Fig. 892, Plate XI., the revolving armature is in the form of a central boss, *P*, into which are fixed 10 or more radial bars, *D*, of soft iron, circular in section, and slightly conical, and each wound with a coil of insulated copper wire, the ends of which are connected together in series and to a cylindrical commutator. The armature wheel revolves in the field of two powerful electro-magnets, *A A*, fixed vertically into an iron base-plate, by which they become the two limits of a horse-shoe electro-magnet. The cores of the radial magnetic inductors as they revolve approach very close to the poles of the inducing magnets *A A*, being at their point of closest proximity when in horizontal position. When the machine is revolving in the direction of the arrow all the radial bobbins above the horizontal line are receding from the left hand, the South pole of the magnet, and approaching the North pole, and the bobbins below the horizontal line *vice-versa*, the currents in the upper half of the circuit are in one direction, and those below are inverse.

The coils are coupled together in series, and each pair of contiguous coils is connected to a sector, *C*, of the cylindrical commutator, there being as many sectors as bobbins, and insulated from one another by strips of vulcanized rubber. Against the surface of this commutator collectors are pressed by springs, the one taking off the positive current and the other the negative, and the currents so induced are transmitted through the coils of the large vertical electro-magnets, the machine being on the dynamo-electric or reaction principle.

The figure shows a Lontin machine with 4 induction wheels fixed on the same shaft, each wheel carrying 10 bobbins. The bobbins are mounted helically on the shaft, so as to avoid any interval of inaction.

Up to the period of the invention of the Pacinotti machine the armature had its magnetism reversed as it rotated, involving a loss and waste of power. The Italian inventor devised the idea of the ring, and rotating the ring between the poles of a magnet in such a way that there should be no reversal of poles, but merely the traveling of the poles around in the ring. This ring was surrounded with wires from which the induced current was taken. The idea involved was embraced in the Gramme machine, and accepted by electricians only after much dispute and opposition. Gramme appears, however, to have been an independent and original inventor.

The Gramme machine, Fig. 893, Plate XI., consists of a permanent field magnet, between the poles of which are armatures of peculiar construction, formed by coiling around a soft-iron core a wire of copper, forming the entire coil into an endless bobbin, in the shape of a cylinder or ring; the wire being provided at suitable intervals with metallic rods or conductors for allowing the proper exit of the electric current generated. These rods extend axially of the core, and at their ends on diametrically opposite sides of said axis connect with two rolling commutators which lead to line.

It must be said, however, that neither Pacinotti nor Gramme originated the ring armature; for Elias, in 1842, constructed an electro-magnetic motor, the armature of which was an annular coil surrounding a ring core, having 6 polar protuberances at equal distances apart, and which revolved within a similar ring, forming the field-magnet.

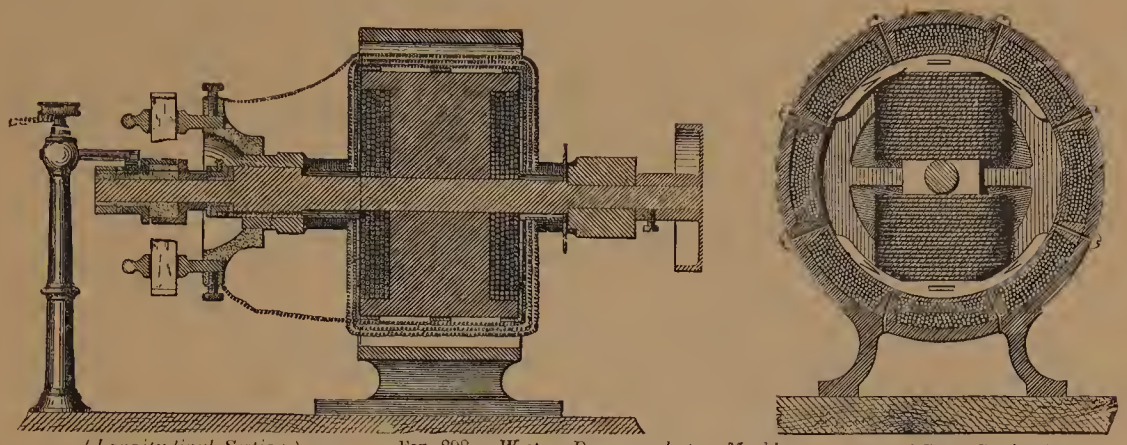
In Fig 893, Plate XI., *H* is the permanent electro-magnet, having additional poles, *h h'*, of a circular shape, so as to correspond with that of the cylinder or endless large bobbin, *A*. The poles are kept insulated from each other by means of the non-magnetic portions, *i i'*, and the large bobbin or cylinder *A* is composed of a continuous series of small bobbins connected end to end, the junctions being each connected to a conductor, *C*, which conductors are kept insulated from each other; on the free ends of these conductors act the rubbers or connecting rollers, *S S'*, for carrying the currents respectively to the posts *X X'*. The cylinder, or large bobbin, *A*, revolves by means of the shaft *D* in standards *B*, and motion may be transmitted to the shaft *D* by means of the crank *I*, and pulleys, or other mechanical contrivances. A^2 represents the soft iron core of the cylinder or large bobbin *A*.

In the earlier form of the Gramme machine the inventor mounted three rings upon one spindle, each revolving within the magnetic field of two very large rectangular electro-magnets. One of these rings supplied the current by which all the electro-magnets were excited, and the others were united so as to produce the external or useful current. But in the newer and far more powerful machines this arrangement is superseded, there being but one induction ring, and the coils of the electro-magnet are included in the circuit, the whole of the current traversing them. Fig. 894, Plate XI., represents the modern Gramme machine, such as is used for illumination purposes. The ring is mounted on a horizontal shaft which is revolved at a speed of 900 revolutions per minute within the electric field of the four horizontal electro-magnets shown in the cut. The two upper magnets are united to a common pole-piece, which embraces about three-eighths of the circumference of the ring, and the two lower magnets are connected to a similar pole-piece opposite in polarity to that attached to the upper magnets.

The Siemens machine, Fig. 895, Plate XII., has a cylindrical armature, the "longitudinal induction bobbin" revolving between two double poles of two pairs of electro-magnets.

The armature consists of a metallic cylinder with copper wires wound axially over its surface. The peculiar system of winding is the invention of Von Alteneck, who was thus associated with Dr. Siemens in the device. The system of winding and the possible variations are the subject of an elaborate article by M. Breguet, published in "*Engineering*" and reproduced in "*Van Nostrand's Engineering Magazine*," * xxii. 375.

These longitudinal coils of wire completely envelop the iron cylinder or armature, each section being wound parallel to a different plane passing longitudinally through the axis of the cylinder, there being as many of such planes as there are sections to be wound, and at equal angular distances from each other around the circumference of the



(*Longitudinal Section.*) FIG. 898. *Weston Dynamo-electric Machine.* (*Cross Section.*)

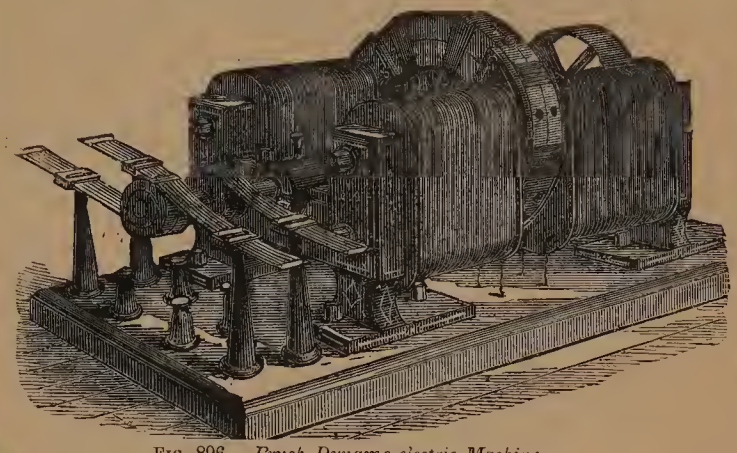


FIG. 896. *Brush Dynamo-electric Machine.*

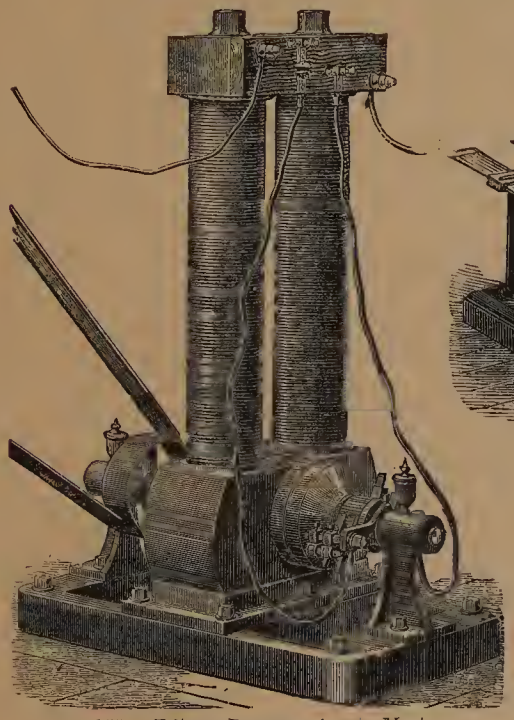


FIG. 900. *Edison Dynamo-electric Machine.*

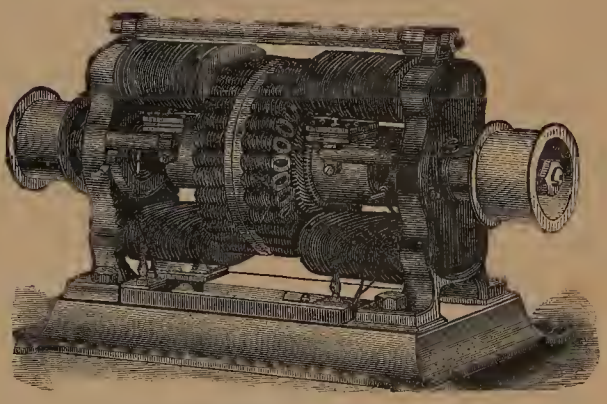


FIG. 897. *Wallace-Farmer Dynamo-electric Machine.*

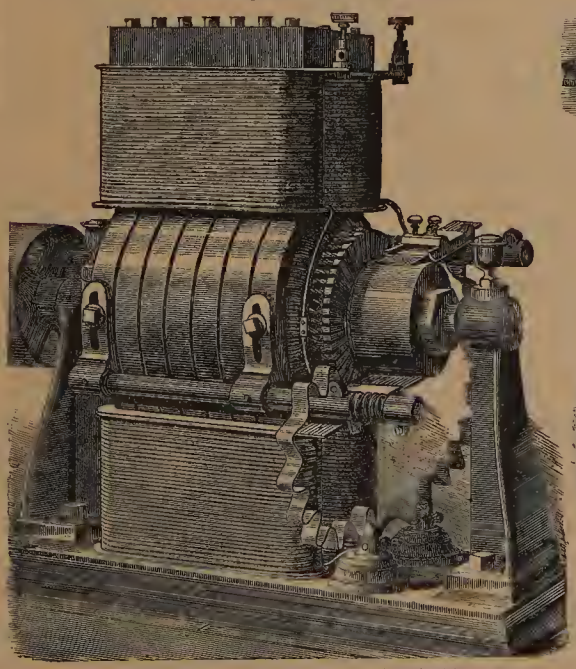


FIG. 899. *Maxim Dynamo-electric Machine.*

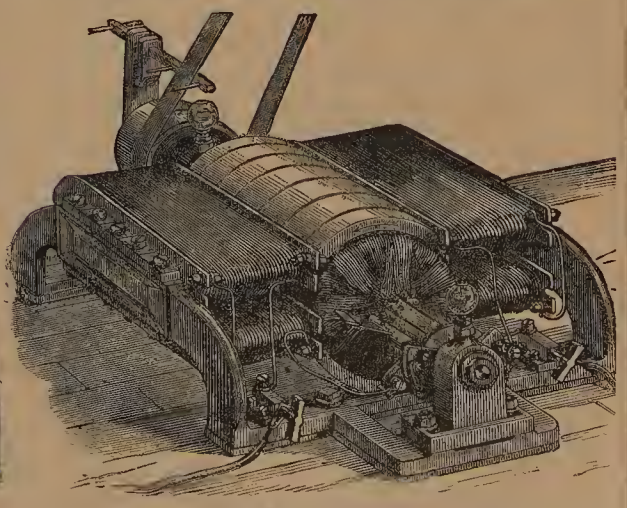


FIG. 895. *Siemens' Bros. Dynamo-electric Machine.*

cylinder. The ends of these coils are connected to a number of copper sectors insulated from one another, which together build up a cylindrical commutator rigidly attached to the armature spindle with which it revolves; and the currents are collected in a similar manner by conducting brushes pressing against the commutator as it revolves.

This system, consisting of the iron cylinder with its enveloping coils, is rotated at a high velocity within a powerful magnetic field produced by a series of electro-magnets, the coils of which are included in the circuit of the rotating armature through the brushes, and are magnetized thereby. The curved bars, seen above and below the revolving armature, are of soft iron of rectangular section, and are the prolongation of the cores of the powerful electro-magnets, shown on each side of the armature, the cores of which are long flat bars wound with insulated wire.

The magnet cores, instead of being flat continuous plates, are divided longitudinally into several bars having air spaces between them, the object of which is, firstly, to prevent cross-currents being induced in the magnets; secondly, to maintain the lines of magnetic force parallel to the length of the bar; thirdly, to permit of a circulation and escape of air between the revolving armature and the magnets, so as to reduce the accumulative heating of the machine; *lastly*, for convenience of manufacture.

Of the curved portions of the magnetic cores, each surrounds two sixths of the entire circumference of the induction cylinder, so that two thirds of it are embraced by the magnets, and the coils of each set of magnets are so wound as to produce a point or pole in the center of the length of the cores, a North consequent pole being produced at the mid-length of the upper set of magnets, and a South consequent pole being produced at the corresponding point in the lower set of magnets. Thus a very intense magnetic field is formed within the cylindrical space included between the upper and lower sets of magnet bars, and within this space is revolved at a high velocity the induction cylinder or armature, which has been described.

In the Brush machine, Fig. 896, Plate XII., the wires are wound in slots in the revolving cylinder, and the projecting parts between the slots are brought nearer to the faces of the poles of the field magnets than in the Siemens machine.

Referring to Fig. 896, the machine is seen to consist of two large horse-shoe electro-magnets placed with their similar poles facing each other, the armature revolving between them. The currents are generated in the coils of copper wire wound upon the armature. The coils are 8 in number, opposite ones being connected end to end, and their terminals carried to the commutator, which consists of segments of brass, secured to a ring of non-conducting material carried on the shaft. The commutator is so arranged that at any instant 3 pairs of coils are interposed in the circuit of the machine. The current is conveyed from the commutator by means of brushes made of strips of hard brass joined together at their outer ends and connected with a binding screw on the base.

The Wallace-Farmer machine, Fig. 897, Plate XII., has a magnetic field produced by two electro-magnets, with the poles of opposite character facing each other. Between the arms of the magnets, and passing through the uprights supporting them, is the shaft, carrying at its center the rotating armature. The latter consists of a disk of cast-iron, near the periphery of which, and at right angles to either face, are iron cores wound with insulated wire, thus constituting a double series of coils. These armature coils being connected end to end, the loops so formed are connected in the same manner on to a commutator of the same construction as that of the Gramme. As the armature rotates the cores pass between the opposed North and South poles of the field magnets, and the current generated depends on the change of polarity of the cores.

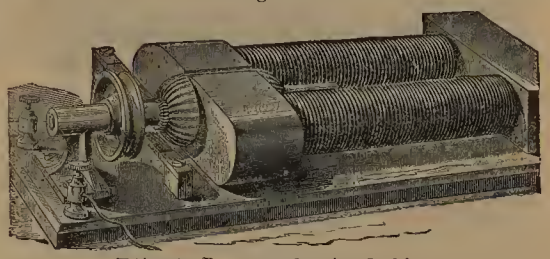
In the Weston machine, Fig. 898, Plate XII., the rotating magnet is inclosed in stationary coils in an annular stationary iron shell. The coils are wound in cylindrical form upon a skeleton frame of non-magnetic material, within which the electro-magnet rotates. The latter is mounted upon a neutral axis, and its periphery moves in close proximity to the surrounding coil. Apertures at the end of the cylinder admit air into the space within the coils. The skeleton frame is divided into 8 segments, and each of the three coils traverses the entire exterior of the skeleton frame, extending across the ends of the cylinder, from the segment on one side to the segment diametrically opposite, and the free ends of the coil are respectively connected with two stationary brushes bearing upon directly opposite sides of the cylindrical commutator.

In a late patent of Weston, the skeleton core is rendered discontinuous by a series of deep transverse grooves, and by a longitudinal slit from end to end of the armature, and currents of air are passed through to counteract the heat produced by the resistance of the current, and which might destroy the insulation and does increase the resistance.

Maxim's dynamo-electric machine, Fig. 899, Plate XII., has an armature of soft-iron rings with the wire wound parallel with the axis, both plates and wires being so arranged that a free circulation of air is admitted through the armature to prevent dangerous heating. The commutator is large and heavy, and the sections enrved in a right and left spiral, so as to avoid any break in the current.

Maxim's current regulator, a governor for dynamo-electric machines (Patent No. 228,543), is automatic in case of an over-current to cause the operation of electro-magnetic de-

Fig. 901.

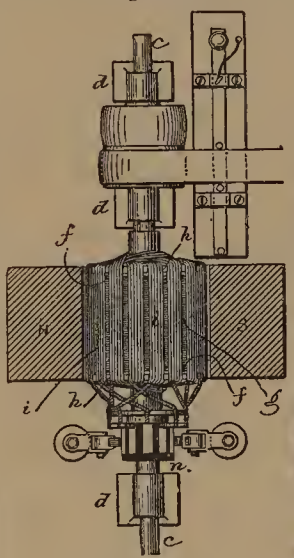


Edison's Dynamo-electric Machine.
(*Field Magnet, Horizontal.*)

vices, releasing or bringing into action mechanism for shifting the position of the brushes, and thus reducing the current.

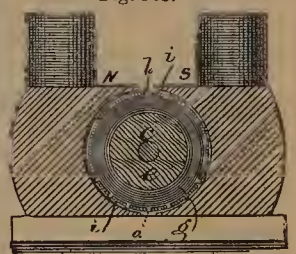
The Edison magneto-electric machine, Fig. 900, Plate XII., and Figs. 901 to 905, has a revolving armature, a cylinder of wood with two iron heads, and around the cylinder and between the heads fine iron wire is wound. At the ends of the cylinder, outside the iron heads, are disks of hard rubber, and the wires forming the induction helix are wound lengthwise of the cylinder into notches in the edges of the disk.

Fig. 902.



(*Top View.*)

Fig. 903.



(*Transverse Section.*)

Edison's Dynamo-electric Machine.

The Edison machine exhibited at the Electrical Congress, Paris, 1881, is shown in Figs. 904, 905, and is thus described by Comte Th. du Moncel: —

"The field magnets were arranged as a derivation taken from the commutator, putting it into the induced circuit, as in Wheatstone and Siemens' systems. Then the armature was arranged on Siemens' principle, so that the wire consisted of bars of copper. These bars lie close to each other around the cylinder which forms the armature, and they generate the current. Their

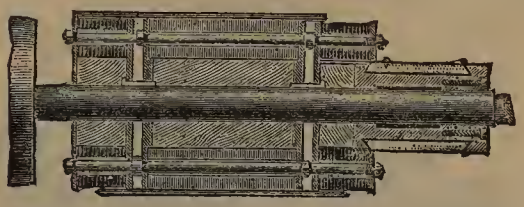
Fig. 904.

Revolving Armature of Edison's Dynamo-electric Machine
(*Detached*).

extremities correspond to disks of copper (at right angles to them) laid one against the other at the ends of the cylinder, and insulated from each other. Each bar is fastened to its corresponding disks in such a way as to form a single circuit enveloping the cylinder longitudinally, and which is made perfect through the coupled bars two and two with the commutator blocks (made after the Gramme pattern). Figs. 904 and 905 give an idea of this new arrangement. The center of the cylinder itself is occupied outside of the rotating

axle by a cylinder of wood, which, in its turn, is surrounded by a thick tube made of a series of very thin disks of iron, separated from each other by tissue paper. This arrangement facilitates the rapid changes of polarity in the plates. This tube is terminated at its two extremities by two thick clamping disks which are made to compress the others laterally, and the copper disks of the working coil occupy the two compartments at the extremities of the cylinder, as seen in Fig 905. Under such conditions as those the resistance of the generator is small, and permits of great subdivision of the current in multiple arc; nor is there any insulation to be burned, and it is even possible, in case of deterioration of the bars, to renew them easily, for they are simply screwed against the upper disks corresponding to them. In another arrangement adopted by Mr. Edison, the field magnets lie horizontal instead of being placed vertical."

Fig. 905.



Revolving Armature of Edison's Dynamo-electric Machine (Longitudinal Section).

Seeley's disk armature is an amplification of the idea of "Arago's disk." The disk is constructed of insulated wire revolving in a magnetic field arranged radially with reference to the axis of the armature.

The disk consists essentially of wire wound in radial directions, so that the radii on entering may be moved before magnet poles of the same name, while the radii outgoing move before the opposite poles. The whole mass of the disk, so far as it is practicable, is filled out or made up of the radial winding, and the sectors of out and in wires are equal in number and symmetrical in form and arrangement.

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Gary . . . . . * "*Sc. Amer.*," xl. 144, 145, 151.
Gramme . . . . . * "*Engineering*," xxviii. 63, 327, 412.
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Hefner-Altenek . . . . * "*La Lumière Electr*," iii. 431.
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* "*Sc. Amer. Sup.*," 1223, 1814.
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* "*Van Nostr. Mag.*," xxii. 406.
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Societé l'Alliance. See "Alliance."
Transmission of power by electricity. "*Engineer*," xliv. 451.
"*Van Nostr. Mag.*," xx. 334.
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Wallace-Farmer . . . . * "*Engineer*," xlv. 447.
* "*Iron Age*," xxiii, Jan. 9, p. 7
* "*La Lumière Electr.*," ii. 343.
Western Union Telegraph * "*Scientific Am.*," xlii. 63.
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* "*Scientific Amer.*," xxxv. 150.
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* "*Journal Soc. Tel. Eng.*," viii. 235, pl. 5; * 240, pl. 8.

Dy-nam'o-graph. (*Surgical.*) An instrument for registering the muscular power of the hand of an individual applied to the compression of an elliptic spring. See DYNAMOMETER.

Dyn'a-mom'e-ter. 1. (*Surgical.*) An elliptic spring with indicating finger and graduated arm, to be collapsed by the grasp of the hand, as a measurer of the muscular power of the hand of the individual.

Fig. 283, Part 1, *Tiemann's "Armam. Chirurgicum."* Another instrument has a bulb to be compressed by the hand, ejecting a liquid which rises in a tube against a graduated scale. Fig. 285, *Ibid.*

2. A machine used for testing the lifting strength of persons. See HEALTH LIFT; LIFTING MACHINE; EXERCISING MACHINE.

3. An instrument for measuring the compression exerted by a charge of powder in explosion.

Such an instrument is also known as an *internal-pressure gage*, or a *piezometer*; each of which see.

Lieut.-Col. Benton's dynamometer is designed to be used in connection with the Rodman pressure gage, for the purpose of determining the pressure per square inch exerted within the bores of cannon and small arms by the ignition of powder. It may also be used for testing the strength of materials, or for measuring their compression within certain limits.

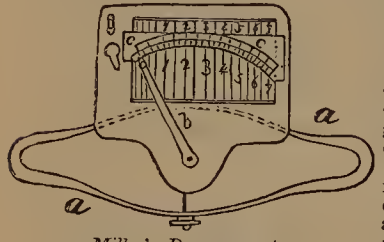
The apparatus is described in the "*Report of the Chief of Ordnance, U. S. A.*," 1877, * 374 and Plates I.–V.

Lieut. Metcalfe's dynamometer for measuring the recoil of fire-arms, measures the recoil by means of a cut made in a material of uniform resistance, such as copper or lead, by a Rodman knife interposed between the metal and the butt of the gun. See Appendix N and plate, "*Ordnance Report*," 1878, p. 109.

4. An instrument for measuring tractile force exerted by an engine or team.

A simple form is that of Miller. It is self-registering, and consists of an ordinary dynamometer spring, *a a*, with needle, *b*, and graduated scale, *c*.

Fig. 906.



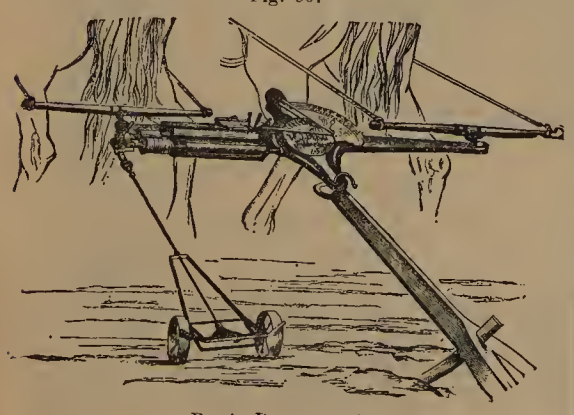
Miller's Dynamometer.

A strip of paper carefully ruled to correspond with the graduated scale is caused to pass under the needle at a uniform rate, by means of rollers moved by a train of gearing, with a fly to regulate the motion. This mechanism is inclosed in a box beneath the graduated scale. Every impulse of the power is accurately noted upon the graduated paper by a pencil attached to the needle, enabling the operator to determine, not only the mean and extreme draft, but also the unsteadiness of draft as indicated by the range of vibration of the needle.

The instrument is connected to the object, the draft of which is to be tested, and to the power used, by a hook and clevis.

The dynamometer of *Berg*, Kjöbenhavn, Denmark, is shown in Fig. 907. Draft upon the double-tree condenses a

Fig. 907

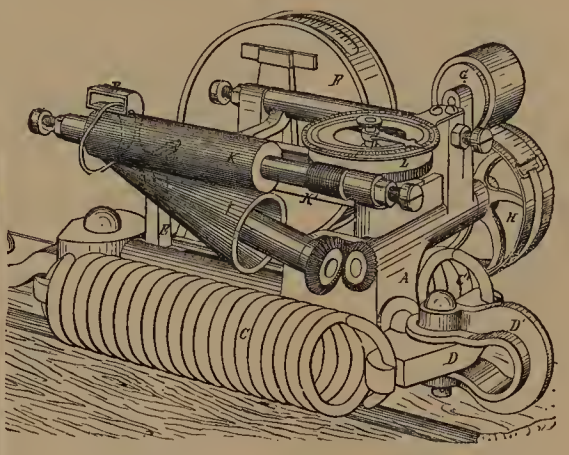


Berg's Dynamometer.

spring and causes a pointer to traverse a graduated sector and show the force exerted. Attached to the pointer arm is a rod which moves a traversing pencil, the point of which rests on a traveling band of paper, which is rotated by a small trailing carriage.

The dynamometer of *Baldwin & Eickemeyer* was used at the Centennial Exhibition in 1876 in testing the mowing machines. It differs from other dynamometers in so far as it compounds the average draft applied to the machine for a

Fig. 908.



Baldwin & Eickemeyer's Dynamometer.

given distance, — say, 100 feet, — and thus facilitates the tests very materially, as all calculations of diagrams are avoided.

Two coiled springs, *C C'*, united by cross-bar *D*, and attached by clevis *D'* to the double-tree of the team, form the connection between the draft-power and the pole of the machine to which the apparatus is hooked. The cross-head *D* is the forward end of a T-shaped bar fitted into the frame on the extreme end of which the belt-guide *E* is fastened. The position of the belt-guide thus depends upon the amount of power applied to the clevis *D'*, as the springs lengthen or contract by variations in the said force.

To record and average the draft so applied is the function of the recording mechanism. The base-line of 100′ is measured by a tape line 100′ long, wound up in the tape case *F*, which is drawn out through a slot and passes between the rubber friction roller *G* and the driving pulley *H*. One end of a string is fastened to the ring in the end of the tape line and the other end of the string to a peg in the ground. As soon as the team starts, the tape line begins to pay out, turning the driving pulley *H* until the 100′ is expended, and setting in motion the recording mechanism which ceases when the tape is expended. A pair of bevel wheels connects the shaft of the driving roller *H* with the conical roller *I*, giving it a determined number of revolutions during the expenditure of 100′ of tape

Above the conical roller *I* is a parallel roller *K*, which is sustained on conical end screws, and its shaft carries a worm *K*, which engages the gear on the periphery of the drum of the indicator dial An endless cord passes between the rollers *I K*, issuing through a guide *F*, carried by the post *E* on a stem of the T-bar *D* When no strain is applied to the clevis *D'*, *E* is at the rear position shown in the cut, and were the apparatus even in motion by means of the strain upon the tape line, the end of which was fast to the ground peg, no indication would be given upon the recording dial, because as the endless cord is on the point of the roller it gives no motion to the roller *K*, and, through the latter, to the dial. When, however, strain is brought by draft on the clevis *D'*, the endless cord is drawn forward, and the cord passes between rollers *I K* at such point between the apex and the base of roller *I* as the draft may have occasioned The heavier the draft the larger the portion of the roller *I* traversed by the cord and in exactly the same proportion is the motion of the roller *K* and accordingly of the dial. Any fluctuation in the draft exerted is immediately manifest by the creeping of the cord toward the point or toward the base, as the power exerted diminishes or increases, and equally, the indicator travels more or less slowly. The extent of the motion of the indicator is the sum of all the effects, and it is set to zero at the commencement of each trial.

The reading of the indicator is the perfected record, and no calculations of diagrams are necessary.

Emerson's dynamometer, in one form, is shown at 5, Fig. 1813, p. 768, "*Mech. Dict.*" Quite a variety of lever dynamometers, fixed and portable, are now made on this principle. These dynamometers are graduated by applying the

DYNAMOMETRICAL TRIALS OF REAPERS AND MOWERS AT MARMONT (SEINE-ET-MARNE) FRANCE, JULY 25, 1878.

Designation of machines.	1. At work. 2. Moving; in gear but not cutting. 3. Moving; not in gear.	Surface of Diagram, measured by the Planimeter.	Length of Trace on Paper of Dynamometer.	Mean Ordinate.	Corresponding Effort.	Width of Cut.	Effort corresponding to one Meter of Width of Cut.	Length of Course.	Time of Course.	Rate of Motion per Second.	Stroke of Knife.	Weight of Machine.	Weight of Driver.	Total Weight.	Price of Machine.	Estimate of Power required to cut: † One Hectare of Wheat. ‡ One Hectare of Lucern.	Weight of Wheat cut per Square Meter.	
		Square Millimeters.	Meters.	Millimeters.	Kilogrammeters.	Meters	Kilogrammeters.	Meters.	"	Meters.	Meters.	Kilos.	Kilos.	Kilos.	Francs.	Kilogrammeters.	Kilos.	
Cyrus H. McCormick's binding-reaper.	1	22.580	1.284	17.58	184.48	1.48	124.66	110	78 6	1.400	0.149	544	92	636	2,000	†1,246,600	0.8446	Mean of work by the four reapers, 0.8155 kilos per sq. meter = 8,155 kilos per hectare.
	2	*54,550	1.298	*43.03	128.49	1.48	86.82	110	77.4	1.290	0.149	544	92	636	2,000			
	3	*43,160	1.386	*31.14	95.19	1 48	64.32	110	83.4	1.320	0.149	544	92	636	2,000			
Walter A. Wood's binding-reaper.	1	29,840	1.642	18.18	190.78	1.51	126.34	110	114.8	0 958	0.137	544	92	636	2,000	†1,263,400	0.7947	
	2	38,270	3.059	12.51	131.28	1.51	86.94	110	119.0	0.924	0.137	544	92	636	2,000			
	3	12,890	1 223	10.54	110.61	1.51	73.35	110	86.0	1.280	0.137	544	92	636	2,000			
D. M. Osborne & Co.'s binding-reaper	1	20,560	1.225	16.73	176.09	1.58	111.45	110	78 6	1.400	0.077	533	92	625	1,750	†1,114,500	0.8228	
	2	17,945	1.300	13.80	144.32	1.58	91.66	110	92.2	1.193	0.077	533	92	625	1,750			
	3	11,100	1.206	9.22	96.75	1.58	61.63	110	75.6	1.455	0.077	533	92	625	1,750			
Johnston Harvester Co 's reaper	1	10,960	1.115	9.83	103.16	1.50	68.77	110	89.0	1.236	0.075	458	92	550	1,050	†687,700	0.8000	
	2	6,290	1.002	6.28	65.90	1.50	43.93	110	84.3	1.305	0.075	458	92	550	1,050			
	3	5,550	1.055	5.26	55.20	1.50	36.80	110	80.2	1.372	0 075	458	92	550	1,050			
Aultman's mower, "Buckeye."	1	*20,900	0.721	*28.29	88.62	1.27	69.78	110	78.6	1.400	0.070	325	92	417	625	‡697,800	. . .	Mean of work by the four mowers, 1.355 kilos per sq. meter = 13,550 kilos per hectare.
	2	*19,180	1.196	*16.04	49.03	1.27	38.61	110	92.2	1.109	0.070	325	92	417	625			
	3	*16,070	1.148	*14.00	42.80	1.27	33.70	110	95.0	1.158	0 070	325	92	417	625			
Warder & Mitchell's mower, "New Champion."	1 ††	*32,350	1.384	*23.28	71.47	1.28	55.84	110	117.2	0.939	0 076	258	92	350	675	‡619,300	. . .	
	1 ‡‡	*22,820	0.880	*25.93	79 27	1.28	61.93	110	117.4	0.937	0.076	258	92	350	675			
	2	*18,050	1.349	*13.89	42.46	1.28	33.17	110	110.2	0 998	0.076	258	92	350	675			
	3	*10,860	0.936	*11.60	35.46	1.28	27 70	110	98.0	1.120	0 076	258	92	350	675			
William Anson Wood's mower	1	*27,230	0.986	*27.52	84.13	1.28	65 73	110	81.2	1.122	0 070	295	92	387	675	‡657,300	. . .	
	2	*19,280	0.558	*16.65	50.90	1.28	39.77	110	74.2	1.482	0.070	295	92	387	675			
	3	*15,180	1.196	*13 53	41.36	1.28	32.31	110	83.6	1.316	0.070	295	92	387	675			
Walter A Wood's mower	1	*36,080	1 549	*28.29	71.20	1.29	55 99	110	99.4	1.107	0.069	254	92	346	675	‡564,500	. .	
	2	*23,970	1.363	*17.58	53.74	1.29	41.66	110	82.6	1 332	0.069	254	92	346	675			
	3	*11,470	0.900	*12.74	38.95	1 29	30.19	110	79.0	1.392	0.069	254	92	346	675			

Meter = 39 37079 inches, approximately 1 1-10th yards
Millimeter, 1-1000 meter = 0.0394 inch.
Kilo, *i. e.*, kilogram = 1,000 grams = 2.2046 pounds avoirdupois, approximately 2 1-5th pounds.
Kilogrammeter = a force of 1 kilo exerted through 1 meter.
Hectare = 2 471 acres.

* Essays marked thus * employed the dynamometer with the weaker springs; the other essays were with a more powerful instrument.
†† Ordinary height of stubble. ‡‡ Extra short stubble.
The dynamometer used was that belonging to the *Conservatoire des Arts et Métiers* of Paris. Tests and calculations by Professor Tresca, *fils*, of the *Conservatoire*

weights at a point which, if revolving, would describe a circle of a given number of feet, the smallest size at 4, the larger from 10 to 60, depending somewhat upon the speed they are run.

The same method is used to compute the power as described in water-wheel tests. Suppose the instrument to be graduated upon a 4′ circle, pulley making 500 revolutions per minute, weight indicated after deducting centrifugal force, 35 pounds, $500 \times 4 = 2{,}000 \times 35 = 70{,}000 \div 33{,}000 = 2.12$.

The manner of using the portable dynamometer is to place it between the motor and the machine to be tested, level and secure it to the floor, then belt from motor to driving pulley of dynamometer, and observe the weight indicated, caused by centrifugal force of the levers (equivalent to balancing scales), then belt from pulley of dynamometer to pulley of machine, from the weight then indicated, deduct the centrifugal force, then compute as before described.

These dynamometers are usually made in two sizes. The small size, capable of testing up to 5-horse power, and large one up to 25-horse power.

The table on the opposite page gives the tests of harvesting machines at the Paris Exposition of 1878. The trials took place at Marmont near Paris, and the writer was member of the special jury as well as of the class. It is appended as indicating the thorough method of testing: —

The machine operating in crop.
The machine operating but not in crop.
The machine empty, moving but not in operation.
The column "Estimate of power required to cut one hectare" is the ultimate result *in nuce*.

See the following references: —

Batchelder . . . . . * "*Sc. Am.*," xxxix. 127.
* "*Sc. Am.*," xxxviii. 130.
Blackinton . . . . . * "*Sc. Am.*," xxxvii. 66.
Eastern Ry. of France, Car. . . * "*Engineering*," xxvi. 290, 307, 330.
Edison . . . . . "*Sc. Amer.*," xli. 86, 276.
Froude, Propellers . . . . . * "*Eng'ing*," xxiv. 67, 90.
Propellers . . . . . * "*Sc. Am. Sup.*," 1407.
Giffard, Balloons, Paris, 1878 . . "*Sc. Am.*," xxxix. 179.
Hausner, Fabrics . . . . . * "*Sc. Am. Sup.*," 1236.
Killiches, Locomotives, Ger. . . "*Van Nostrand's Mag.*," xix. 560.
Maxim . . . . . * "*Manuf. & Builder*," xii. 223.
Reaper trial, Br., 1876 . . . . "*Sc. Am. Sup.*," 681.
Prony brake . . . . . * "*Sc. Am. Sup.*," 704, Fig. 7.
"*Sc. Am.*," xxxviii. 130.
Electric currents, *Weber* . . . * "*Sc. Am. Sup.*," 3985.

Dynamometer for threads and tissues, article *Dynamomèter, Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

Dynamometers of *Tresca*, *Morin*, *Bentall*, *Ibid.*, tome i., article, *Dynamomètr*.

See also Testing Machine, and list under Measuring Instruments, *infra*.

Dyne. (*Electricity.*) The unit of *force*, namely: A force which, acting on a mass of one gram, for one second, imparts a velocity of one centimeter per second or increases or diminishes the initial velocity of such mass by that amount. — *Gordon.*

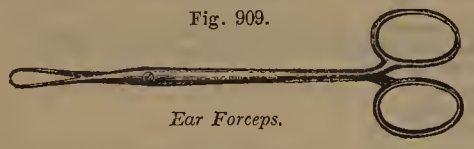
Dy'si-ot. A German alloy, a whitish brass, readily fused.

Copper	62
Lead	18
Tin	10
Zinc	10
	100

E.

Ear For'ceps. (*Surgical.*) An instrument for extracting foreign bodies from the external meatus.

Fig. 909.



Ear Forceps.

The prongs are fine, and come into complete apposition in the mode of some bullet forceps. *Dr. Francis H. Brown.*

Ear In'stru-ments. (*Surgical.*) These are of three kinds: —

1. For exploration and diagnosis.
2. For operation.
3. For prothesis.

See: —

1. Otoscope.
Reflector.
Diagnostic tube.
Ear probe.
Explorer.
Tuning fork.
Specula.

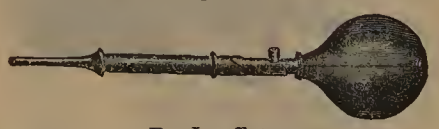
2. Curette.
Hook for foreign bodies.
Polypus knife.
Polypus forceps.
Polypus snare.
Eustachian catheter.
Meatus knife.
Eustachian canal inflator.
Ear spoon.
Powder blower.
Port acid glass.
Mastoid process knife.
Ear syringe.
Eyelets and eyelet forceps.
Angular forceps.
Tympanum perforator.
Nose clamp.
Tensor tympani instr.
Air-bag.
Ear forceps.
Capillary spray instrument.
Maryngotome,
Bistoury.

3. Auricle.
Apparitor auris.
Ear trumpet.
Cornet.

Ear Lift'er. (*Harvesting.*) A long projecting guard finger on the knife bar of a reaper, to insinuate itself beneath the grain which has been storm beaten, or laid in the field. A row of lifters is placed in advance of the regular guards. *Hornsby.*

Ear Pow'der-blow'er. An instrument to introduce powder into the ear by the way of the

Fig. 910.



Ear Insufflator.

external meatus. One section of the stem has a sliding cap, which is withdrawn to allow the powder to be introduced. Compression of the bulb ejects the powder at the nozzle. A form of syringe.

See Auto-insufflator and Atomizer, Figs. 128, 131, pp. 55 and 57 respectively, *supra.*

Ear Spout. A trough which hangs by a wire to the ear and conducts outflow water to a basin, while syringing.

Earth Bat'te-ry. (*Electricity.*) One in which the elements are imbedded in the earth to be acted upon by the moisture of the ground.

Cerpaux's earth electric battery consists of a combination of plates of zinc and copper, separated by slats and blocks of wood, inserted in moist earth or sand.

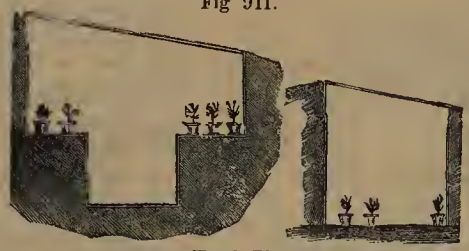
"*Scientific American Supplement*" . . . . . 452, * 2489.
Sabine's "*Electric Telegraph*" . . . . . 230.
"*Scientific American Supplement*" . . . . . * 774.
"*Scientific American*" . . . . . xxxiv. 296.

Earth Flax. Amianthus. See Asbestos.

Earth Pit. A sunken trench or pit, Fig. 911, in which to protect plants during winter, using the heat of the earth below and around, and excluding the cold above by means of sashes, and any necessary shutters or matting in very cold weather. A cold pit.

Earth'quake In'di-ca'tor. An instrument to indicate, and in some instances record, the per-

Fig 911.



Earth Pit.

turbations of the ground in case of earthquakes. See SEISMOMETER, "*Mech. Dict.*," *et infra.*

Ea'sel. A frame or tripod on which a hoard, canvas, or other object is supported at a convenient angle for drawing, plotting, or painting.

That shown is by Boudriot, of Hague, Germany.

The drawing board is suspended from two sliding frames by ropes passing over pulleys on the top of the easel, and it

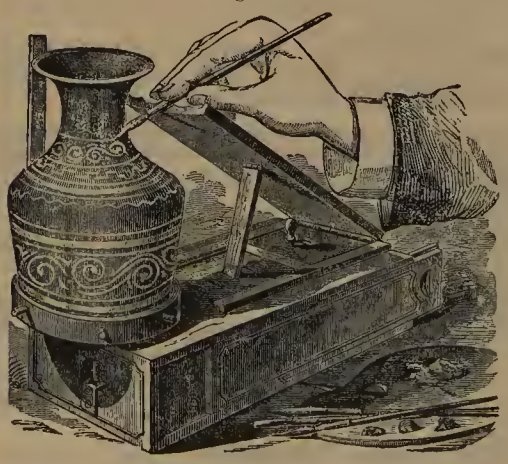
Fig. 912.

Draftsman's Easel.

is balanced by a ball weight attached to the ropes. The board can be inclined at any angle by means of adjustable telescoping struts. The easel has adjustable arms, carrying sliding carriages, from one of which a lamp is suspended, and a small table for the instruments from the other. The easel can be adjusted to suit persons of different heights, and to accommodate different kinds of work.

Fig. 913 shows Brownell's easel for painting and striping pottery. The vase is placed on the turn-

Fig. 913.



Porcelain Painter's Easel.

table, and the hand-rest adjusted to a convenient height and position to bring the hair pencil to bear upon the object, which is chucked on the table by means of centering pins in the flanged rim.

Eas'ing Valve. A small valve in the center (say) of a large valve, the former being lifted by a moderate power, to equalize the pressure before the large valve opens.

"*Engineer*," xlv. . . . . *Cormack*, * 188. *McNaught*, * 297. *Borsig*, * 297.

Eb'o-nite. Another name for hard black rubber. The inventor, Charles Goodyear, between 1840 and 1850, made a number of finely molded articles in this material.

It is produced by the process of vulcanization, the heat, quantity of sulphur, and time employed being in excess of the ordinary vulcanization. The hard and fibrous rubbers of the Malayan Archipelago are preferred to the Para or the African rubber for this purpose.

The carefully washed and dried rubber is mixed by means of heated rollers with from 25 to 50 per cent. of sulphur (which must be free from acid), according to the hardness required. 3 per cent. of lampblack may be added to improve the color, and calcined magnesia is sometimes added. The material becomes plastic while hot, and non-elastic when cold.

The ebonite is cured in steam at 135° C. during a period of from 6 to 10 hours, according to the thickness of the article. At a heat of 140° to 150° C. the process is shortened.

Ebonite in its plastic state is molded in tin, type metal, or tinned brass molds. A very slight application of oil, followed by black-leading, prevents adhesion.

Ebonite works like horn or ivory, and can be turned, but requires a high rate of speed. It is dressed down by flour-glass paper and fine emery, and polished by cloth charged with fine brick-dust and water, oil, or paraffine; subsequently by rotten-stone or tripoli.

When heated, it may be bent to shape, so that articles such as bracelets are made flat, heated to 100° C., and bent to shape. Junctions are easily made in the vulcanizer when the ebonite is not at its hardest condition.

The uses of ebonite depend largely upon its properties of hardness, elasticity (in certain grades), electrical non-conductivity, compactness, inertness toward most chemical products, capacity for shaping by molds, turning, polishing.

Gutta-percha, shellac, asphalt, graphite, are added to some compositions, and sulphur as high as 60 per cent. An approved formula is

Rubber	100
Sulphur	45
Gutta percha	10

Combined under heat. Molded in a material not affected by the sulphur; exposed to a heat of 315° F. in a steam pan, at a pressure of 12 pounds to the square inch.

Eb'o-ny, Ar'ti-fi'cial.

Boil oak wood for 48 hours in a solution of alum, and then brush over with a decoction of logwood, prepared as follows:—

Boil 1 part of logwood in 10 parts of water; filter, evaporate to one half. To each quart of this solution add 12 drops saturated neutral solution of indigo.

After the application of the dye rub the wood with a saturated filtered solution of verdigris in hot, concentrated acetic acid, and repeat till the required black color is attained.

Or. Boil 2 quarts of water with ½ pound of logwood and add 1 ounce pearl-ash; wash the wood with this first, and then with the following wash: 2 quarts of water boiled with ½ pound of logwood, ½ ounce sulphate of iron, ½ ounce of acetate of copper, and ½ pound rusty steel filings.

Or: Dip in a solution of logwood. When dry, rub clean, dip in a solution of bichromate of potassium; dry and rub again.

Or: Wash repeatedly in a solution of sulphate of iron. Dry; then wash repeatedly in hot solution of logwood. Dry; wash with sponge and water. Dry; rub with linseed oil.

See the following references: —

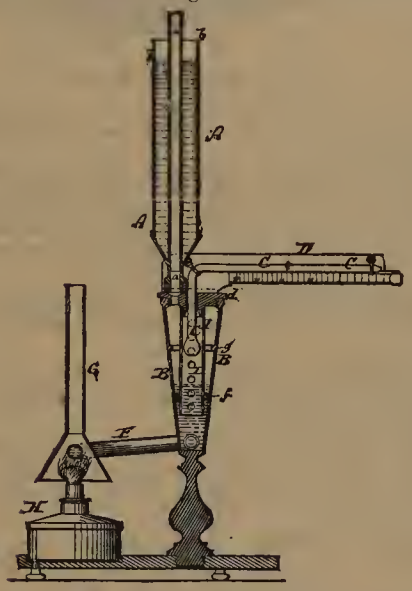
Ebonite	"*Iron Age*," xxiii., April 10, p. 1. "*Manufac. & Builder*," ix. 96, 120. "*Scientific American Sup.*," 4008. "*Mining & Sc. Press*," xxxii. 23.
Ebonizing wood . . .	"*Eng. Mechanic*," xxv. 142, 165. "*Manufac. & Builder*," x. 240. "*Mining & Sc. Press*," xl. 263. "*Scientific American*," xxxviii. 191, 219, 251; xxxiv. 40. "*Scientific American*," xxxvii. 137, 145.

"*English Mechanic*," xxv. 644.
Imitation . . . . . "*English Mechanic*," xxvii. 135.
Polishing . . . . . "*English Mechanic*," xxiii. 363.

E-bul'li-o-scope. (*Add.*) The ebullioscope of M. Malligand, of Paris, is an instrument for ascertaining the quantity of alcohol present in liquids. U. S. Patent, No. 173,128.

It was found by the Abbé Brossard-Vidal that alcohol holding certain matters in solution, such as sugar, resins, citric

Fig. 914.



Malligand's Ebullioscope.

and tartaric acids, gives a different result, the presence of these matters in moderate quantities not affecting the boiling-point of the alcohol in which they are dissolved. This fact led to the method of estimating the proportion of alcohol present in wines and other alcoholic liquors by comparison of their boiling-points with the boiling-points of different mixtures of alcohol and water in known proportions.

In using the apparatus, pure water is placed in the boiler until it reaches the lower ring *f*, or mark, in the boiler. The water is then boiled, the boiling-point being noted by bringing the zero of the movable scale *E* opposite the degree indicated by the mercurial column *C*. The water is then replaced by the liquid to be tested, care having been taken to rinse out the boiler with some of the same, so that no water is allowed to remain. The boiler is then filled up to the upper ring *g*, or mark, in the boiler, and cold water supplied to the condenser-vessel *b*, attached at the top of the instrument. The lamp is then lighted, and as soon as the mercurial column becomes stationary in the stem, then, by means of the mercury above the scale *E*, the degree of the boiling is at once indicated.

The peculiarities of the instrument consist in the condensers *a b* for returning the vapors of the liquids under test, so as to keep them at normal strength; in heating the liquid in detail by pipe *F* through the flame, thus insuring circulation and proximate equality of temperature throughout the boiler *B*.

See HYPSOMETER, for the instrument for ascertaining altitudes by the observation of the boiling point of water.

E'bur-ine. Dust of ivory or bone compounded with gum tragacanth or albumen, by pressure and heat; colored at pleasure. The name adopted by the French inventor, Latry.

A cement is usually added, but the organic matter in the bone seems to answer if the heat be carefully regulated.

The material is a grayish-white, but may be colored by pigments, an addition which renders albumen necessary. It is used in connection with *bois-durci* or wood concrete (made of sawdust and bullocks' blood).

Eburine may be colored and molded, and made to imitate jasper, malachite, lapis-lazuli; to form moldings, seals, cameos, ornaments of various kinds.

Latry . . . . . "*Technologiste*," xxxix. 221.

See list under COMPOSITIONS, p. 212 *supra;* also EBONITE, p 290.

E'bur-ite. See EBURINE.

Ec-cen'tric Chuck. An oval and eccentric lathe chuck of considerable range and variety of work is shown in "*English Mechanic*," and reproduced in "*Scientific American Supplement*," * 1413.

See also *Penney* . . . . . * "*Engineering*," xxv 308.

Ec-cen'tric Clamp. A lifting arrangement for stone monuments, columns, pillars, etc., which should not be defaced by leaving holes or by clamps which mar the surface of the object.

Fig. 915.

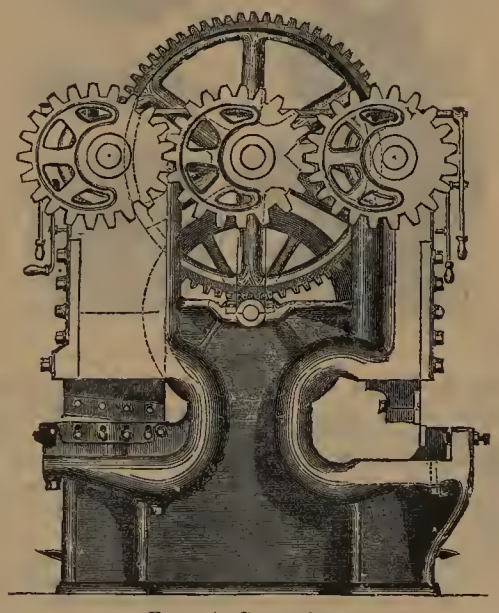
Eccentric Clamp.

The lifting of the load turns the eccentrics and binds the rubber-faced plates firmly against the object. The size is adjusted by the turnbuckles at the sides.

Ec-cen'tric Geared Press. An iron-shearing and punching twin-power press in which the power is transmitted through eccentric gearing.

The middle shaft receives a uniform velocity by its large spur-wheel driven by a pinion below. On this shaft is an elliptic gear hung eccentrically, which alternately imparts to the eccentrics on the right and left respectively a slow motion during the penetrating down-stroke and a rapid motion

Fig. 916.



Eccentric Geared Press.

during the up-stroke, increasing the power two-fold in the former case and the speed two-fold in the latter, proximately. The greater part of the upward stroke is in fact accomplished in one-sixth of the time occupied in the revolution of the shaft carrying the shear or punch, as the case may be.

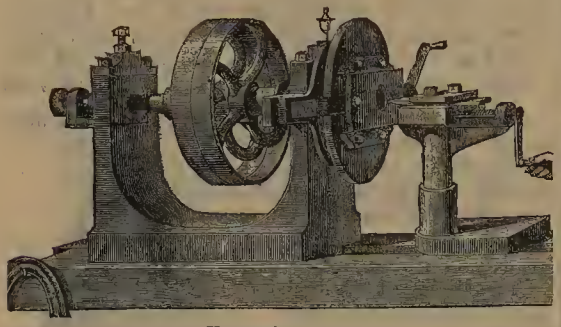
Ivens & Brooks . . . . . * "*Engineer*," xli. 450.

Ec-cen'tric Lathe. A lathe with a compound face plate or sliding frame with guides by which the object is so presented that the tool works an oval upon it.

Maxwell of Cincinnati, in 1866, made an important improvement in so arranging the lathe that the amount of ponderable weight was at all times the same on every side of the axis, independent of the piece being turned. This prevented the very serious vibration incident to rapid running of eccentric lathes not thus arranged.

The machine shown in Fig. 917 is made by *Arbey* of Paris.

Fig. 917.

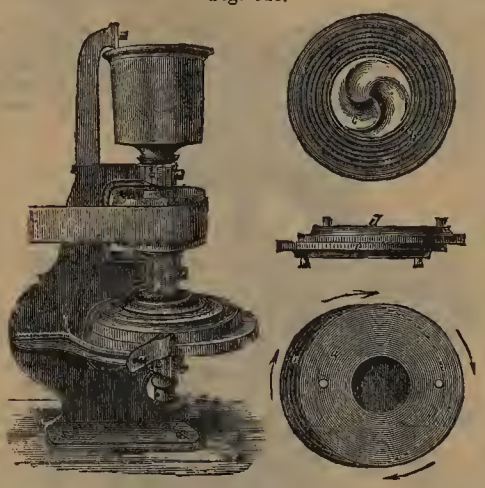


Eccentric Lathe.

Ec-cen'tric Mill. In the Bogardus eccentric mill, both plates revolve in the same direction (with nearly equal speed), on centers, which are apart from each other one or two inches, more or less; the center of the one, or the axis thereto affixed, resting on, or revolving upon a stationary bearing; whilst the prime mover, by means of a belt or gearing, causes the motion of the other plate.

The driven plate communicates motion to the

Fig. 918.



Bogardus Eccentric Mill.

other, the circles which are cut in the plates acting as a revolving shears. The faces of the plates are variously formed for different purposes.

Ec-cen'tric Valve. A stop valve moved by an eccentric upon the valve stem, or, as in the case cited, by an equivalent motion of a short-throw-crank.

See *Elliott & Burnett*, Br. . . * "*Engineer*," xliv. 193.
* "*Engineering*," xxiii. 98.
* "*Sc. American Sup.*," 1570.

Ech'o-scope. (*Surgical.*) An instrument invented by Dr. Speir to intensify sounds produced by percussion of the thorax.

Fig. 267, p. 83, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

E-con'o-mi'zer. An apparatus for heating the feed water by the waste heat from a boiler or furnace. See FUEL ECONOMIZER.

E-cra'seur. (*Surgical.*) A flexible loop for cutting, or tearing loose a tumor, polypus, etc.

The following figures refer to *Tiemann's* "*Armamentarium Chirurgicum.*"

The écraseurs of *Chassaignac*, *Edwards*, *Emmett*, *Tiemann*, and *Barnes*, for uterine and ovarian tumors, are jointed chains. Pages 92, 93, Part III. Of the same class, is *Sims'* porte chain écraseur, Fig. 470, Part III.

The instruments of *Smith*, *Braxton*, *Hicks*, and *Van Buren* for the same purposes, are of wire. *Ibid.*

The galvano-cautery sling or écraseur, *Ibid.*, p. 100. See also, *Ibid.*, p. 113, Part I.

Gibbs' Laryngeal écraseur, *Ibid.*, Fig. 338, Part II.

Some écraseurs are shown under CAUTERY INSTRUMENTS, *supra.*

The écraseur of *Dr. J. Harry Thompson* is designed for the rapid removal of uterine polypoid growths. It enables

Fig. 919.

Dr. J. H. Thompson's Ecraseur.

the operator to readily pass the chain around the tumor, the steel springs keeping it taut until the tumor has been completely encircled.

Dr. Nott's rectilineal écraseur is especially intended for the removal of hemorrhoids, and division of the pedicle of ovarian tumors. It is a species of clamp with screw fastening handles, the jaws being respectively a blade and a slit. See Fig. 6, p. 64, vol. vii., Dr. Thompson's report of Group XXIV., * "*Centennial Exhibition Reports.*"

E-de ma-glot'tis Tube. (*Surgical.*) A flat spring ring to be introduced into the glottis to prevent its being closed by swelling.

Edge Grind'stone. One the peripheral edge of which is the portion utilized; as distinguished from surface grindstone.

Edge Key. A tool used in boot-making for rubbing and burnishing the edges of soles. The disks are made of patterns: plain, convex, scotch edge, fluted, etc.

Edge Laid Belt. One made by cutting up the hides into strips of the width of the intended thickness of the belt, and setting them on edge. These strips have holes punched through them about $\frac{1}{8}''$ diameter and 1″ apart. Nails, made of round wire, clinched up at one end for a head and flattened at the other, are used for fastening the leathern strips together.

Edge Mold'ing Ma-chine'. One for cutting moldings on the edges of boards, the latter lying upon a table and presented to a revolving cutter which projects upwardly through a hole in the table. Fig. 3200, p. 1468, "*Mech. Dict.*"

Bentel, Margedant & Co. * "*Manuf. and Builder*," xii. 153.
* "*Engineer*," xli. 412.

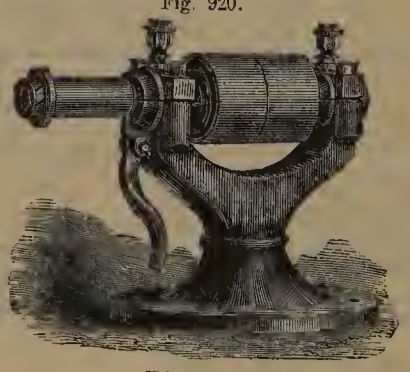
Edge Pla'ning Ma-chine'. A planing machine specially arranged and adapted for planing the edges of boiler and armor plates. Sir Joseph Whitworth's machine operates on plates up to 15′ length.

Edge Rolled Spring. A flat bar laid spirally as in *v*, Fig. 1143, p. 483, "*Mech. Dict.*".

Edge Set'ter. A small lathe for burnishing the edges of boot soles.

In the Tayman edge setter the shoe is carried on a jack and the burnisher held in the hand.

Fig. 920.



Edge Setter.

Edge Trim'mer. (*Boot-Making.*) A small machine for paring the boot sole. The boot is held on a jack, moving automatically, and the knife trims the edge and takes out the feather. — Tayman.

Edg'ing and Di-vid'ing Bench. A circular saw of special adaption for sawing blocks into voussoir shapes, used in one form (Mansel's, Br.) of carwheels.

The bed is moved to and fro by a screw, and the travel of the bed is adjusted and determined by the movable projections attached to the bed, which, by communicating motion to the system of levers, throw the strap on to one of the three pulleys for stopping, or for motion in one or other direction. The table has a fast return motion given it by means of a double ring of cogs, on the crown wheel fixed to the screw.

Robinson, Br. . . . . * "*Engineer*," xlv. 216.

Edg'ing Ma-chine'. (*Machine-tool.*) A machine with horizontal adjustable bed, and one or more cutters on vertical spindles: used for milling around the inside or outside edges of irregular shapes, and for surfacing and inside milling. A *profiling machine*. Jones, Lamson & Co.

The *Pratt & Whitney* edging machine has an accurate automatic movement for cutting circles of less than 3″ diameter, and their tangents. Made with one, two, or three spindles.

Edg'ing Saw. A circular saw arranged upon a bench for ripping boards to make strips or straight-edges. The board is placed on a movable table and fed past the saw. See also DOUBLE EDGER.

Eel Spear. (*Fishing.*) A spear, Fig. 921, with 3 or more barbed prongs for catching eels by thrusting it into the mud they inhabit. See also GRAINS.

Patents: S. Hedges . . . . . No. 172,312.
C. M. Knowles . . . . . 218,540.

Egg Beat'er. The Dover egg-beater has two revolving flat loops on different shafts, each passing alternately inside of the other, gathering the egg towards the center of the bowl and whirling it in cross currents.

Fig. 921.

Eel Spear.

Fig. 922.

Dover Egg-beater.

The following references may be consulted: —

Beater, *Mann* . . . * "*Scientific American*," xlii. 115.
Boiler . . . . . * "*Scientific American*," xxxviii. 354.
Paper cup, *Washburne*, * "*Scientific American*," xxxv. 195.
Dessicated . . . . . "*Sc. Am.*," xxxvi. 275, 408; xl. 88.
Holder, *Birch* . . . * "*Scientific American*," xli. 399.
Guilbeault . . . . . * "*Scientific American*," xxxv. 131.
Opener, *Kry* . . . . * "*Scientific American*," xxxix. 328.
Tongs, *Koška* . . . * "*Scientific American*," xlii. 83.

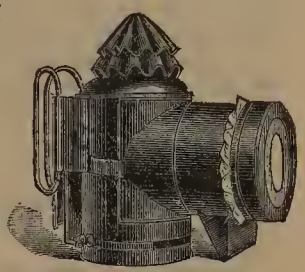
Egg'-end Steam Boil'er. A form of steam boiler with hemispherical ends. When of large size, the longitudinal seams are double riveted. When dished ends are used, the larger sizes have longitudinal or gusset stays, or both.

Egg'-shell Ware. (*Ceramics.*) A name applied to very thin porcelain, resembling the egg-shell in its extreme lightness. Made in Japan, and imitated in Europe.

See Prof. Wurtz, Report (Centennial) on Japanese Porcelain.

Egg Test'er. A dark lantern, having an opening at which an egg is placed in order to observe the condition of its contents; the translucency of a fresh egg, or the condition of the embryo chick observed. The fertility of the egg can be determined after being under heat for 48 hours. Used for commercial purposes in testing freshness of eggs, and in connection with incubators in observing the fertility of the egg and progress of the embryo.

Fig. 923.



Egg Tester.

E-ject'or. A form of pump. See p. 775, "*Mech. Dict.*"

Friedmann's . . . . * "*Scientific American*," xli. 319.
Nagel & Kaempt . . . * "*Scientific American Sup.*," 292.
Vacuum brake ejector . * *Forney's* "*Dictionary*," 435.

E-las'tic Wheel. (*Railway.*) A car-wheel in which some elastic material is interposed between the tire and the wheel-center or hub to resist the concussions. Different substances are used, such as paper, wood, india-rubber, oakum, etc. See Figs. 1170, 1171, pp. 493, 494, "*Mech. Dict.*"

El'bow. A bent pipe coupling or L joint. See also BEND.

El'bow Ap'pa-ra'tus. (*Surgical.*) 1. An apparatus for the gradual extension of contracted muscles of the arm; false anchylosis of the elbow.

Fig. 53, Part IV., *Tiemann's* "*Armam. Chirurgicum.*"

2. A splint for luxated elbow.

Hamilton's elbow splint, Fig. 148, Part IV., *Ibid.*
Andrews' elbow splint, p. 123, Part IV., *Ibid.*

El'bow Scis'sors. (*Surgical.*) Scissors bent in the blade or shank for convenience in cutting. See several instances in Figs. 4671, 4672, p. 2054, "*Mech. Dict.*"

El'der Brake. (*Railway.*) A brake for eight-wheeled cars, with a horizontal lever having a fixed fulcrum under the car-body, at its center, and pulleys at each end, over which a chain passes, which is connected with the brake-levers of each truck. One lever on each truck also has a pulley or sheave at its end, over which a chain runs which is connected with the opposite lever, and also with the central lever. The latter is connected by rods and chains with brake-windlasses by which the brakes are applied at each end of the car. — *Forney.*

E-lec'tri-cal Di'a-pa'son. An apparatus invented by George M. Hopkins, for compounding rectangular vibrations, so as to produce both sounds and figures.

Sir Charles Wheatstone contrived a small machine for the purpose, using tuning-forks; *Prof. Dolbear* used mirrors on a whirling table to describe curves upon a screen; *Lissajou* drew curves by means of two pendulums. In each of these there was a certain incompleteness; the forks lacked continuity of action, the mirrors gave no sound, the pendulums (as arranged without sustaining power) had neither continuity nor sound. It must be said, however, that *Lissajou* has, since his first invention, applied electricity to maintain the vibration of the diapason.

Hopkins' apparatus has two reeds or tongues vibrated by an electric current and connected with a single mirror, the latter receives a beam of light from a lantern and reflects it

through a lens upon a screen. The steel tongues are pivoted at one end and are arranged relatively so that they vibrate in planes at right angles to each other. They are thus the equivalent of the Lissajou pendulums. The image upon the screen is the resultant of the two rectangular vibratory motions.

If only one tongue vibrates a straight line will appear on the screen, which will be inclined at an angle of 45° from the horizontal. The line produced by one of the tongues forms a right angle with the line produced by the other, and when both tongues vibrate simultaneously the two motions combine, and the reflected pencil describes a more or less complex curve, the form of which depends on the number of vibrations of the two tuning-forks in a given time.

The tones of the tongues are varied by moving the slide so that any possible combination of tones within the given compass (in this case an octave and a half) may be produced.

"*Scientific American*" . . . . . xxxix. 223.

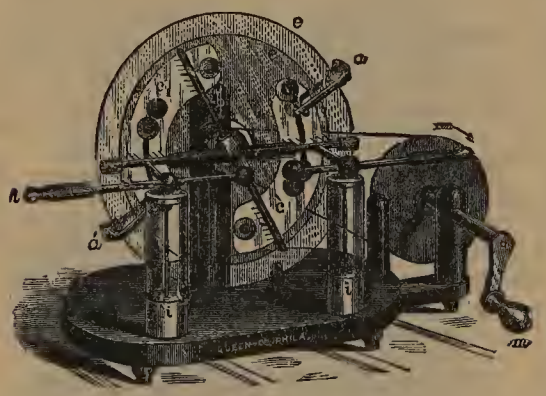
See also COMPARATOR, *Prof. Barnard's Report Paris Exposition*, 1867, * pp. 507–509.

E-lec'tri-cal Gen'er-a'tor. See DYNAMO-ELECTRIC MACHINE; ELECTRO-MAGNETIC MACHINE.

E-lec'tri-cal Ma-chine'. *Franklin's* electrical machine is in possession of the Franklin Institute of Pennsylvania, and was shown at the Centennial Exhibition.

Fig. 925 is the Toepler Holtz electrical machine. The stationary glass plate *e* is held in rubber supports upon the platform, with the armatures *c c* at the back. The inner

Fig. 924.



Holtz Electrical Machine.

circular revolving-plate *e* is attached to the axis, the metallic disks outward. The arms *a a'* are attached to their sockets in such a way that the metallic brush just touches the brass disks when the plate *e* is rotated, but does not touch the plate. *i i* are the condensers.

To operate the machine place the balls close together, turn the wheel in the direction of the arrow until the sparks pass between the balls, then separate them gradually; the wheel-plate being rapidly revolved, a torrent of brilliant sparks will discharge between the balls. The small brass disks on the anterior surface of the plate *e*, when revolved rub against the metallic brushes, on *a a'*, a small quantity of electricity is carried around to the armatures *c c'*, upon the back of the large stationary plate, the initial charge is thus given to the outer plate *e*, this in turn reacts on the revolving plate.

See the following references: —

Holtz, *Carré*, *Thomson*	* "*Scientific American*," xxxvii. 261.
Gramme	* "*Scientific American Sup.*," 674.
Holtz	"*Scientific American Sup.*," 1058.
Military, Fr.	* "*Scientific American Sup.*," 4055, 1456.
Frictional.	
Marum & Winter	* "*Manufac. & Builder*," viii. 204.
Induction, *Holtz*	* "*Telegraphic Journal*," v. 126.
Battery, *Onimus*	* "*Scientific American*," xxxv. 67.
Planté, Paper by Niaudet	* "*Jour. Soc. Tel. Eng.*," vii. 75.
Paper on *Wiesendangir*	* "*Scientific American Sup.*," 4028.

E-lec'tri-cal Sold'er-ing I'ron. A tool for use in tin-shops and at the jeweler's or mechanical dentist's bench.

It consists of two metallic conductors placed side by side, with a small space between them for insulation, and joined at the end by a small piece of platinum or other refractory substance having a high electrical resistance. A handle is provided, having the proper insulation and binding screws for the wires. A simple form of switch is also provided for regulating the current. When the current flows through the tool, the platinum point is raised to a high temperature, and may be used to melt gold or silver solders.

E-lec'tric Bat'te-ry. 1. (*Static.*) The Leyden jars.

2. (*Dynamic.*) The battery consisting of a series of galvanic elements. See GALVANIC BATTERY, and list, *infra*.

E-lec'tric Brush. 1. A brush with wire bristles, and having metallic plates in the handle which cause a galvanic action, especially when the brush is dipped in water or used in brushing the damp hair. — Dr. Post.

2. A brush included in an electric circuit, and used upon the hair or flesh as a therapeutic.

3. A circuit closer consisting of a bunch of wire used in telegraphic instruments using perforated slips.

E-lec'tric Bul'let-probe. (*Surgical.*) An instrument which indicates contact with the bullet by a sound induced by the completion of an electric circuit between the points of the forceps and through the bullet. Fig. 3966, p. 1803, "*Mech. Dict.*"

E-lec'tric Ca'ble. Plow for trenching and laying electric cables (French). "*La Lumière Electrique*," reported in "*Scientific American*," * xlvi. 246.

E-lec'tric Call. An audible signal communicated by electricity. An *annunciator*, *call-bell*, *buzzer*, etc.

E-lec'tric Can'dle. (*Electricity.*) A form of electric light in which the carbons are placed parallel; as in the Jablochkoff light.

The waste of the two must be equal, and they are therefore fed by alternating currents.

1. Candles with *columbin;* that is, a material which separates and insulates them, — the Jablochkoff, which combines the incandescent and the arc.

2. Candles without columbin are arc lamps. The Wilde, Jamin, and Debrun are of this class. The distance apart of the carbons is permanently fixed (*à écart fixe*).

The Clerc and Bureau lamps, known as solar lamps (*lampe-soliel*) have nearly parallel carbons, and are allied to the incandescent class by the interposition of lime between the carbon points made incandescent by the passage of the current across them.

See —

Cohné, Eng.	"*Scientific American*," xli. 265.
Regulator, *Heinrich*, Br.	* "*Engineer*," xlviii. 413.
Jablochkoff	* "*Eng. & Min. Jour.*," xxviii. 45.
	"*Min. & Sc. Press*," xxxv. 42.
	"*Scientific Amer.*," xxxvi. 339
	"*Scientific American Sup.*," 1240, 1249, 1337, 1366.
Planté	"*Manufact. & Builder*," ix. 205.
	"*Manufact. & Builder*," x. 14.
Scaife	"*Scientific American Sup.*," 1720.

E-lec'tric Chro'no-scopes and Chron'o-graphs. References to the following electric chronographs and chronoscopes with electric actuation are to be found in *Comte du Moncel's "Exposé des Application de l'Électricite,"* tome iv., Paris, 3d, edition, at the pages noted: —

	Page.	Figure.	Plate.
* *Atwood* machines	298	9-10	vi.
* *Bashford*	240, 266	51	
Bond	237		
* *Breguet*	207	11	vi.
* *Breguet & Konstantinoff*	211	8	vi.
* *Breguet & Marcy*	232	49	
* *Cornu*	245	55	
Digney	237		

	Page.	Figure.	Plate.
* *Fleurais*	242	52	
Gloesner	218		
* *Hardy & Strange*	227	44	
Hipp	207, 238		
Hirsch & Plantamour	201, 208		
Hughes	250		
Lartigue	250		
Leboulenge	258		
* *Leverrier & Liais*	273	19	vi.
* *Liais*	234	50	
	234	19	vi.
* *Lœwy*	287	57	
* *Marcel Deprez*	228	45	
* *Martin de Brettes*	216, 261	6, 7	vi.
	220	42	
* *Navez*	254	2	vi.
Pouillet	208, 254		
Schultz & Lissajous	225, 267		
Siemens	220		
Thalen	281		
Vignotti	225		
* *Villarceau*	190	41	
* *Wheatstone*	206, 252	1	vi.

See also * *Watkins*, "*Jour. Soc. Tel. Eng.*," ix. 121.

E-lec'tric Clock. (*Horology.*) The first clock, the pendulum of which received its impulse from electricity, was probably that of Mr. Bain.

The bob was made with a hole through it, and passed over two soft-iron cylinders, alternately magnetized by an electrical current at each beat of the pendulum.

An accurate regulator may control a number of subsidiary clocks, either upon the foregoing plan or by electricity operating upon their escapements, so as to cause their pallets to move the escapement wheel, the pinion of which drives the wheels to which the hands are connected.

In Shepherd's gravity escapement the pallet is raised by a temporary magnet, and then acts on the pendulum when swinging in one direction. Subsequently he made his magnets to attract and repel alternately.

Carpenter & Martin . . . * "*Telegr. Journal*," vi. 221.

Electrical clocks are made by —

Autenreith & Himmer, New York.
E. Deschiens, Paris.
Dumontin, Paris.
E. Barbier, Paris.
A. Postel & Co., Paris.
Matt Hipp, Neufchâtel.
Arzberger, Brunn.
J. B. Kerz, Mayence.
J. Ferucci, Udine, Italy.
B. Egger, Vienna.
M. Illitsch, Vienna.
A. Gerard, Luttich, Belg.
Paul Miller, Cologne.

References to the following electric clocks and time markers may be found in *Comte du Moncel's "Exposé des Applications de l'Électricité,"* vol. iv., Paris, 3d edition, at the pages noted: —

	Page.	Fig.	Plate.
* *Anthoine et Langreynay*	155	51	
* *Bain*	43, 68		
	115	17	I.
* *Breguet*	49	11, 12	I.
	51	4	V.
	55	14	
	68	5	V.
	152	7–10	III.
* *Callaud*	15, 156	32	
See also du Moncel, 2d ed., i. 317.			
* *Caselli*	33	5	
	27, 64	3	
* *Collin-Wagner*	70	19	
Combettes	138		
* *Detouche*	52, 127	8, 9	I.
		8	IV.
* *du Moncel*	42	16	I.
	78	1–6	III.
		14	V.
Elec. Chr. Strikers	91–108	11, 12	III.
* *Everts*	16	5	IV.
Faye	20		
* *Foucault*	12	14	I.
Fournier	41		
* *Froment*	126	4	II.
See also du Moncel, ii. 120.	20	4	I.
* *Garnier*	20	1–3	I.
	13	9, 10	II.
* *Garnier fils*	143	6, 7	V.
Gérard	151		
Gloesner	13, 67		
Gondolo et Perret	56		
* *Grasset*	141	13	III.
* *Hipp*	52	13	
	147	27–30	
* Italian	42	16	I.
Jones	85		
* *Kaiser*	58	2	IV.
	58	15	
* *Kerikuff*	166	35	
* *Laguérenne*	61, 94	7	IV.
* *Lasseau*	72	6	IV.
	145	12	V.
	145	20	
* *Leclanché & Napole*	8	1, 2	
	37	7	
* *Liais, E.*	11	4	IV.
	120	24	
	31	16	III.
	19	15	I.
	117	1	II.
* *Mildé*	34	6	
	158	3	IV.
	158	33, 34	
	100	22, 23	
* *Mouilleron*	154	11, 12	II.
* *Nollet*	48	10	I.
* Paris Observatory	87	21	
* *Régnard*	46	8–10	
	81	20	
* *Robert-Houdin*	28	5, 6, 13	I.
	135	11	V.
	127	5–10	II.
	127	25	
See also du Moncel, ii. 118.			
* *Royer*	139	13	II.
Perpet. calendar	169	36	
Siemens & Digny	54		
* *Vérité*	86, 124	3	II.
* *Volcke*	45	1	IV.
	12	2	IV.
Weare	115		
* *Wheatstone*	13, 64	16–18	

E-lec'tric Disk. A concave hollow pan, filled with hot water and included in an electric circuit, used upon the flesh therapeutically. *Electro-Masseur.*

E-lec'tric Egg. An electric manifestation in an egg-shaped glass vessel exhausted of air, and having conductors above and below. The connection with the induction coil being made, the tuft of light between the rods assumes an ovoidal form and becomes more nearly spherical as the air becomes more rare.

Hopkins . . . . * "*Scientific American Sup.*," 2645.

E-lec'tric Fur'nace. An invention of Dr. C. W. Siemens for melting in a guarded crucible highly refractory metals. It has the advantage of compactness, obviates the need of chimney, is more economical in the concentration of the effect of the energy of coal, and excludes the atmosphere from the object.

In Siemens' furnace, exhibited before the Royal Society, the positive electrode, which was made of iron, entered from below the crucible containing the metal to be melted, whereas the negative electrode, which was a rod of carbon, was attached by means of a lever to a solenoid regulator. The crucible was surrounded by charcoal contained in a copper vessel to prevent loss of heat, and so intense was the heat accumulated that in about 20 minutes two pounds of broken files were completely melted.

E-lec'tric Gov'er-nor. A device to limit the passage of an electric current. There are many forms and purposes; some are referred to subjectively as in connection with the electric light.

Siemens' electric current governor is founded upon the stretching of a wire by the heating incident to the passage of the electric current through it. This idea is the foundation of some of the devices in electric arc-lamps for regulating the distance between the carbons, and also one or more of the *Edison* regulators for limiting the passage of the current in the process of subdivision of current for the multiplication of lights.

Siemens' device for giving sensitiveness and promptness by increased radiating surface of the strip is shown in

"*Electrician*," reproduced in "*Scientific American*," *xl. 184.

See also DIFFERENTIAL; REGULATOR.

E-lec'tric Ham'mer. An apparatus consisting of three hollow coils of insulated wire having a movable core or rod of soft iron which is free to move up and down under the axial attraction of the coils when a current circulates in them. The central coil is traversed by a constant current which magnetizes the rod or hammer, and the two extreme coils are traversed by alternating currents from a dynamo-electric machine in such a manner that they alternately attract and repel the magnetic rod up and down so as to make it beat like a hammer. The range of blow is limited on one side by a spiral spring placed within an elastic cushion. — *Siemens & Halske.*

The apparatus is primarily intended for working a rock drill.

The idea is familiar in dental pluggers. Fig. 3837, p. 1750, "*Mech. Dict.*"

E-lec'tric Hose. An arrangement by which the fireman at the nozzle may communicate with the engineer at the fire-engine.

A wire runs along in the cotton or rubber part of the hose, continuing the connection as each section is attached, and over this passes electricity, generated by one of the fly-wheels of the engine. Connected with the nozzle is a little contrivance by which the engineer can be directed to turn on, cut off, slack up, or what not, by signals upon a gong attached to the engine.

"*Manufacturer & Builder*" . . . . . xii. 18.

E-lec-tric'i-ty. Electrical nomenclature settled by the Electrical Congress in Paris, 1881: —

1. The fundamental units to be centimeter, gram, and second (C. G. S.), as heretofore.

2. The practical units, *ohm* and *volt*, to retain their present definition.

3. The unit of resistance, or *ohm*, to be represented by a column of mercury of a square millimeter section at the temperature zero centigrade.

A committee to ascertain and report height of such column in millimeters.

4. The name *ampere* to be given to the *current* produced by a volt in an ohm.

5. The name *coulomb* to be given to the *quantity* of electricity defined by the condition that an ampere gives one coulomb per second.

6. The name *farad* to be given to the capacity defined by the condition that a coulomb in a farad gives a volt.

7. The French *carcel-bec* given the preference over the English "candle-power," and over the German and other standards, as the arbitrary standard of illumination. But this to be considered only provisional and subject to revision.

E-lec-tric'i-ty, Te-leg'ra-phy, etc.

See under the following heads: —

Aërated battery.
Aërophone.
Agglomerated battery.
Alternating current machine.
Alum battery.
Aluminium battery.
Amalgamation.
Anderson battery.
Anode.
Aphongoscope.
Armature.
Articulating telegraph.
Audiphone.
Autograph telegraph.
Autographic printing telegraph.
Automatic repeater.
Automatic signal telegraph.
Automatic switch.
Bagration battery.
Base.
Battery.
Bequerel battery.
Balloon battery.
Bell magnet.
Bell telephone.
Bichromate battery.
Binding-post.
Bi-polar telephone.
Board clip.
Box relay.
Break.
Break circuit.
Breath battery.
Bunsen battery.
Burglar alarm.
Buzzer.
Byrne battery.
Callan battery.
Call annunciator.
Callaud battery.
Call bell.
Call button.
Camacho battery.
Candle.
Carbon battery.
Carbon button.
Carbon indicator.
Carbon telephone.
Carbon-zinc connector.
Carré battery.
Cathode.
Cation.
Cautery.
Cautery battery.
Cell.
C. G. S.
Chloride of lead battery.
Chloride of silver battery.
Chloride of tin battery.
Chromic acid battery.
Circuit.
Circuit breaker.
Clamp.
Clamond battery.
Coil.
Coke consuming battery.
Column battery.
Commutator.
Compound plate battery.
Conductivity.
Conductor.
Connection.
Constant battery.
Constant current.
Contact breaker.
Core.
Couronne de tasses.
Cruikshank battery.
Curb sender.
Current.
Current regulator.
Curves.
Cut-out.
Cyclograph.
Cycloscope.
Daniell battery.
De la Rue battery.
Density.
Dentiphone.
Derivation regulator.
Detector galvanometer.
Dia-magnetic.
Dianemoscope.
Dielectric machine
Differential regulator.
Diffuser.
Diffusion.
Division regulator.
Double connector.
Double-fluid battery.
Dry electric pile.
Dry pile.
Duplex telegraph.
Dynamic electricity.
Dynamo-electric machine.
Dyne.
Earth battery.
Electrical apparatus.
Electrical machine.
Electric battery.
Electric call.
Electric candle.
Electric clock.
Electric diapason.
Electric governor.
Electric hammer.
Electric hose.
Electric lamp.
Electric lantern.
Electric light.
Electric light engine.
Electric light regulator.
Electric measurement apparatus.
Electric pen.
Electric railway.
Electric switch.
Electric telegraph.
Electro ballista.
Electrode.
Electro-harmonic telegraph.
Electrolysis.
Electrolyte.
Electro-magnet.
Electro-magnetic brake.
Electro-magnetic machine.
Electro-magnetic telegraph.
Electro-medical apparatus.
Electrometer.
Electromotograph.
Electro-motive force.
Electro-motor.
Electro-motor copying press.
Electro-motor printing telegraph.
Electro-plating.
Electroscope.
Electro-semaphore.
Electro-silicic light.
Elements.
Engine-room telegraph.
Erg.
Exchange.
Exchange switch.
Extra current.
Fac-simile telegraph.
Farad.
Faradaic generator.
Faure battery.
Filar suspension.
Filings separator.
Fire alarm.
Fire-alarm telegraph.
Fixed interval regulator.
Flowing battery.
Friction machine.
Frommhold cell.
Fulgurata.
Fuller battery.
Gaiffe battery.
Galvanic battery.
Galvanic current.
Galvano-caustic.
Galvano-caustic battery.
Galvanometer.
Gas battery.
Gas-lighting by electricity.
Graphite battery.
Gravity battery.
Grenet battery.
Grove battery.
Harmonic telegraph.
Harmonograph.
Helix.
Hill battery.
Hydraulic electric machine.
Hydrostat.
Incandescent light.
Inconstant battery.
Induced current.
Induction apparatus.
Induction balance.
Induction coil.
Inductophone.
Inductorium.
Inker.
Insulated.
Insulator.
Intensity.
Interrupted current.
Interrupter.
Inversion battery.
Ion.
Jack-knife.
Latimer-Clark battery
Leclanché battery.
Leyden battery.
Lightning rod.
Linkage.
Local action.
Lock switch.
Log.
Magazine battery.
Magnet.
Magnetic battery.
Magnetic inclination, etc., apparatus.
Magnetic induction.
Magnetic instruments.
Magnetic scale.
Magneto call-bell.
Magneto-electric machine.
Magneto-printing telegraph.
Magneto telephone call.
Magnophone.
Many-light regulator.

Marie-Davy battery.
Marine battery.
Maynooth battery.
Mechanical battery.
Megalographe.
Megaphone.
Meidinger battery.
Menotti battery.
Mercury battery.
Micro-battery.
Microfarad.
Microphone.
Microtasimeter.
Microtelephone.
Moist battery.
Monophote regulator.
Motographic receiver.
Motophone.
Mouse-mill.
Muirhead battery.
Muncke battery.
Musical telegraph.
Needle annunciator.
Negative.
Niaudet battery.
Nickel battery.
Non-conductor.
Octoplex printing telegraph.
Ohm.
One-light regulator.
Oxidation.
Pantelephone.
Paper clip.
Para-magnetic.
Paratonnere.
Pencil holder.
Perchloride of iron battery.
Perfluent battery.
Peroxide of lead battery.
Peroxide of manganese battery.
Phonautograph.
Phoneidoscope.
Phonic apparatus.
Phonic wheel.
Phonograph.
Phonomotor.
Phonophone.
Phonophote.
Phonoscope.
Photophone.
Pin switch.
Plunging battery.
Pneumatic battery.
Pneumatic telegraph.
Pneumatic tube.
Pocket relay.
Poggendorf battery.
Polarized relay.
Polarization.
Polemoscope.
Poles.
Polyphote regulator.
Pouci battery.
Porous cup.
Positive.
Potassium-chlorate battery.
Primary coil.
Primary current.
Printing telegraph.
Prism battery.
Private-line instrument.
Private-line printiug telegraph.
Proof plane.
Pseudophone.
Pulvermacher battery.
Pyrophone.
Quadrant electrometer.
Quadruplex telegraph.
Quantity.
Quicksilver battery.
Register.
Regulator.
Relay.
Repeater sounder.
Replenisher.
Reservoir battery.
Resistance.
Rhé electromètre.
Rheophore.
Rheometer.
Rheostat.
Rheotome.
Sal ammoniac battery.
Sand battery.
Sea battery.
Secondary battery.
Secondary coil.
Secondary current.
Security hook.
Seismophone.
Sematrope.
Short circuit.
Shunt box.
Siemens-Halske battery.
Single-fluid battery.
Siphon recorder.
Siphon telegraph recorder.
Siren.
Skeleton bell.
Smee battery.
Soldering pot.
Sounder.
Speaking electric telegraph.
Spiral battery.
Standard battery.
Static electricity.
Stock reporting and printing telegraph.
Storage battery.
Submariue electric ligbt.
Sulphate of lead battery.
Sulphate of mercury battery.
Switch.
Switch-board.
Switch-loop plug.
Switch table.
Tangent galvanometer
Target, electric.
Tasimeter.
Telautograph.
Telectroscope.
Telegraph.
Telegraph cable.
Telegraph cable apparatus.
Telegraph inker.
Telegraph instruments.
Telegraph key
Telegraph pole.
Telegraph wire.
Telemachon.
Telephone.
Telephonc call signal.
Telephonc excbange apparatus.
Telephone exchange table.
Telephonograph.
Telcphote.
Tension.
Thermo-electric battery
Thermo-electric pile.
Thermo multiplier.
Thermophonc.
Thermotelephone.
Thomson battery.
Tom Thumb battery
Topophoue.
Translator.
Transmitter.
Tray battery.
Trembler.
Triple fluid battery
Trough battery.
Trouvé battery
Tyer battery.
Under current.
Underground telegraph wire.
Urine battery.
Vacuum shunt.
Varley battery.
Vibrating armature.
Volt.
Voltaic pencil.
Voltaic pile.
Walker battery.
Weber.
Window tube.
Wire resistance.
Wollaston battery
Writing telegraph.

Consult: —
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Shoolbred's "Electric Light." London.
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See also list of works under ELECTRIC LIGHT, *infra*.

E-lec'tric Lan'tern. A glass envelope for an electric light.

Ground and opal glasses have been used with the Jablochkoff light, but the result is the absorption of from 30 to 50 per cent. of the light.

M. Clémandot stuffs the double glass envelope with glass wool.

The transparent part of the lantern is conical in shape and tapers downward. The walls are made of united glass tubes, like Pandean pipes, each filled with glass wool, and closed at top and bottom to exclude dust. Not more than 15 per cent. of the total light is absorbed by this process; the opacity can be varied at will by introducing less or more wool into the tubes; and the light can be tinted any desired color, either by the stain given to the spun glass, or the tubes which build up the wall of the lantern.

E-lec'tric Light. The history of the electric light commences with the discovery of Galvanism by Galvani, of Bologna, and Volta, of Como; and the voltaic arc was first produced by Davy, in 1813, between the charcoal points of two conducting wires. He used for the purpose a trough battery of 2,000 elements.

The invention had not emerged from the domain of expensive experiment until the discovery of magneto-electricity by Faraday, in 1831. The magneto-electric machines of Pixii, Saxton, Clark, Niaudet, Siemens-Halske, Holmes, and Nollet, followed, and the light was adapted to and used in lighthouses: at Dungeness, in England, in 1862; and at La Heve, in France, in 1863. See DYNAMO-ELECTRIC MACHINE, *supra*, and p. 781, *"Mech. Dict."* The history of the electric light has two branches, the generator and the applicator: the machine, and the light proper.

A great improvement upon the Holmes and "Alliance" (Nollet) machines was made by Dr. C. W. Siemens, who invented a peculiar form of armature known as the inductive cylinder. This was followed in 1866 by the machine of Wilde, who made

the remarkable discovery that if a current from a small magneto-electrical machine was made to pass around the coils of a large magnet, the attractive power of that magnet would be immensely greater than the force of the magnets in a small machine. Thus, by working a small machine, passing the currents through the electro-magnets of a large one, and then taking from the armature of the large one the current to be used, great electric power was obtained in a small compass.

The discovery of the reaction principle of magnetization by Hjorth, of Stockholm, Sweden, in 1854, was a remarkable one in the history of the art, but it seems to have slumbered unnoticed until the announcement by Wheatstone and Siemens, in 1867. By this principle of action a powerful electric current may be generated through the building up of the effects of action and reaction taking place between an electro-magnet and a magneto-electric inductor revolving in its magnetic field and included in the same circuit. The subject has, however, been considered on p. 283, *supra*.

Leaving machines (pp. 283–286, *supra*), it may be said that the electric lights naturally divide into two groups:

Incandescent. *Arc.*

The Werderman is a sort of cross, having an incandescent point with an arc around it.

"The voltaic arc is a portion of the electric circuit, possessing all the characteristics of other portions of the circuit. The molecules entrained constitute between the two points a movable chain, possessing more or less conductivity, and more or less heated, according to the intensity of the current on one hand, and the nature and distance apart of the electrodes on the other. What occurs is precisely as though the electrodes were united by a wire or a carbon rod of very small section, and thus it may be said that the light produced by the voltaic arc and the light produced by incandescence are results of the same cause, namely, the heating of a bad conductor interposed in the circuit." — *Fontaine.*

Each plan has its own class of difficulties to contend with. The arc is formed by the passage of the current between two separated carbons. These burn away gradually, the positive twice as fast as the negative carbon. It is necessary that they shall preserve an exactly equal distance, and this brings the necessity for automatic regulation. It is this feature that has given rise to the greater number of the patents on the arc class of electric lights. Various inventions in this department are due to *Archereau*, *Lacassauge-Thiers*, *Gaiffe*, *Foucault*, *Duboscq*, *Hefner-Alteneck*, *Serrin*, *Browning*, *Siemens*, *Brush*, *Thomas*, *Jamin*, *Thomson-Houston*, *Sawyer*, etc.

The other side of the question, the incandescent class of lights, has also had its own class of difficulties; the necessity for finding a material which shall not appreciably waste when heated to the violent degree necessary. Platinum, iridium, and carbon, are the principal substances employed.

Platinum leaf was preferred to iridium by *Starr*, in his English patent of 1845. (King, Scotch Patent, Nov. 26, 1845, communication.) He afterward used gas retort carbon in a vacuum.

In the case of the carbon, it is of course necessary to exclude oxygen. This has been done in a satisfactory degree by exhaustion, absorption, and exclusion.

By exhaustion, as in *Edison's*, by means of air-pump.

By absorption; by exposure of chemicals which absorb oxygen in the globe.

By exclusion: filling the globe with nitrogen gas, as in *Kosloff's*, *Sawyer's*, *Farmer's*, etc.; or filling the globe with hydro-carbon vapor, as in *Maxim's*. The exhaustive process, and the exclusion by nitrogen, were used by *Depretz*, in 1849, in his incandescent lamp, consisting of carbon in a sealed glass globe.

The *Jablochkoff* candle of two parallel carbons separated by insulation material, belongs to another class.

The multitude of devices is now so great that it is necessary, in the present abridged résumé, to do little more than cite the inventions and give references in the cases of over 100 inventors of electric lights, cited in the list below (pp. 301, 302).

The electric light is now used in lighthouses in Britain, France, Russia, Austria, Sweden, and Egypt. The usual limit is machines equal to 200 carcel burners.

The introduction of the electric light into streets, works, and factories, is treated of in an article reproduced in "*Van Nostrand's Magazine*," xx. 70–84.

Plates XIII., XIV., show the principal electric lamps.

Brush's electric light mechanism consists of an arrangement by which the carbon sticks are automatically adjusted and kept in proper relation. See Fig. 925, Plate XIII.

The movable pencil is surrounded by an annulus which binds it and prevents its descent, until, by the increase of distance between the carbon pencils, the current is so far weakened as to cause an electro-magnet to lower its carbon-holding armature and release the bind of the annulus upon the pencil, which slips downward until, by the proximity of the carbon, a current of sufficient force is established to restore the electro-magnetic device to its former position.

A is a helix of copper wire through which a current flows, making an electro-magnet of the soft iron axial core which carries the carbon-holder *B*. The current passes from point *P* to point *N*, embracing the coil, armature carbon-holders, and carbons *F F'* in its passage.

The axial magnetism produced in the helix by the passage of the current will draw up the core, separating the carbon points far enough to produce the light. As the carbons burn away, the increased length of the electric arc increases its resistance and weakens the magnetism of the helix, and, therefore, the rod and carbon move downward by the force of gravity, until, by the shortening of the arc, the magnetism of the helix is strengthened and the downward movement arrested.

An enlarged view, Fig. 926, Plate XIII., shows the annulus *D*, the armature, carbon-holder *B*, lifting tongue *C'* of the core *C*, clamp *B'*, carbon *F*, set-screw *D'*.

The *Maxim* arc lamp Figs. 927, 928, Plate XIII., has a pair of vertical carbons, the holders of which are so connected by gearing or rolling contact in the case beneath, that they mutually approach and establish the current. Thereupon a current passes, an electro-magnet is excited, and its armature draws downward a cord and separates the carbons, the result of which is the establishment of the voltaic arc. As the carbons waste the arc becomes larger, the resistance greater, the electro-magnet feebler, and the carbons are again gradually approached.

Siemens's is an arc lamp; his improvements concern the regulator by which the degree of proximity of the carbons is automatically accomplished. The upper carbon *B*, Fig. 929, Plate XIII., passes through the core of an electro-magnetic regulator *F*. The lower carbon, *A*, is continually pressed upward by the action of a weight, *a*, and restrained by a clamp, *c*, which loosens as the carbon consumes. The upper carbon is, by the release of a wheel, *f*, allowed to descend as it wastes, and the tube carrying the upper carbon is kept floating in balance by the action of the solenoid *E* on its core *P'*, automatically adjusting the distance of the carbon points to suit the voltaic arc.

The *Skinner & Thomas* arc electric light, Fig 930, Plate XIII., employs (preferably) for the negative electrode an iridium-tipped rod *G*, which is practically indestructible, and secures the immobility of the point of light; the problem of automatic adjustment is thus restricted to the positive electrode *H*, which is of carbon. The maintenance of the predetermined arc-interval until the complete consumption of the positive is obtained by the following means: —

The positive wire *P* from the generator connects with a helix *F* of insulated wire around the non-magnetic bobbin *A*, consisting of a thin, longitudinally split brass tube, the ends of which are respectively secured in collars *B*, *C*, of vulcanite. This helix *E*, constituting the terminus of the positive wire, has an axial extension of twice the length of the carbon rod. From the collar *C* depends the loop *F*, bearing the erect negative *G*, of copper tipped with iridium. Inside the hollow bobbin *A*, is a loosely-fitting soft iron armature, or *suction-core K*, the brass stem of which, *J*, terminates in the clamp of the positive electrode — the carbon *H*. The weight of the core and its adjuncts is nearly balanced by the counterpoise chains and weight-cups of shot, and the diminution of the weight of the consuming carbon is equipoised by the passing over of the chains from the outside to the inside of the helix. To a cross-bar *O*, on the carbon stem *J*, are fastened two erect brass rods, *R*, *R*, on the upper ends of which are two wheels, *Q*, *Q*, which press lightly against opposite sides of the helix *E*, on lines left naked by the removal of the insulating material, establishing electrical connection. One side of the pendant *F* communicates by wires *N' N''* with the negative rheophore.

The action is as follows: —

The shunt wheels *Q Q'*, having, with their supporting frame *O R R'*, been, by means of set-screw *j*, fixed at their proper height relatively to the core *K*, and the counterpoise *M* having been so loaded as to diminish the virtual weight of core and adjuncts to that which just insures their descent at any relaxation of the coil-magnetism, connection of the wires *P N*, with the generator, causes the current to flow as indicated by the arrows, and thus to impart magnetic properties to the helix *E*, which, in turn, results in elevating the core and its attached electrode *H*, so as to create an arc-interval.

Disintegration of the carbon tip increases the arc-interval and consequent tension and decrease of current, with corresponding reduction of coil-magnetism. This permits the

FIG. 925. *Brush Electric Light*

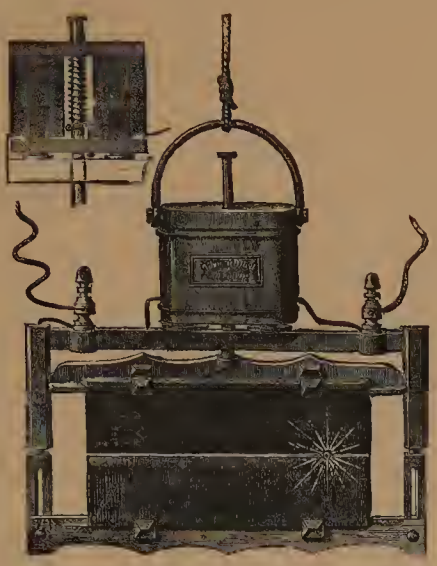

FIG. 932. *Wallace-Farmer Arc Electric Light*

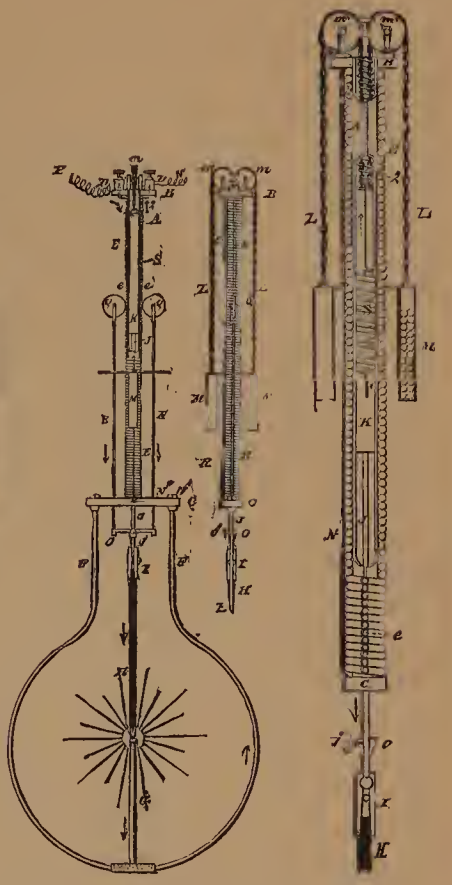

FIG. 930. *Skinner & Thomas Arc Electric Light.*

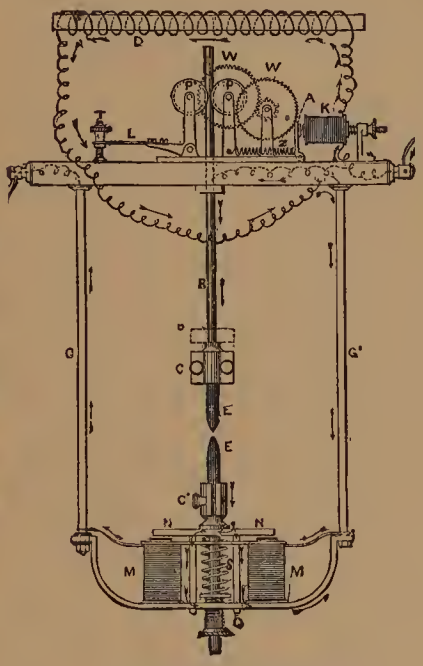

FIG. 931 *Thomson & Houston Arc Light.*

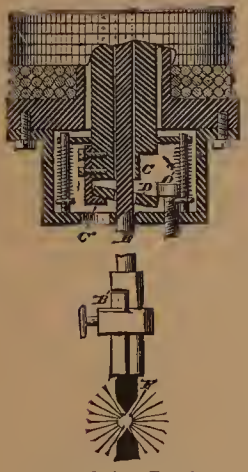

FIG. 926. *Brush Carbon Regulator*

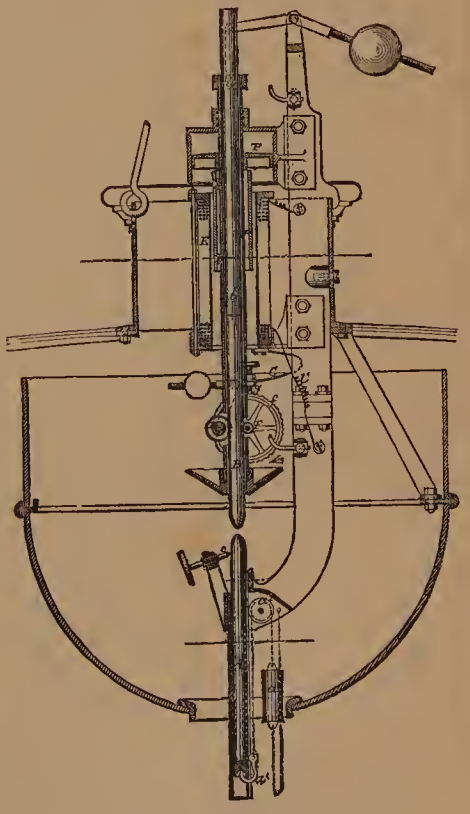

FIG. 929. *Siemens Electric Light*

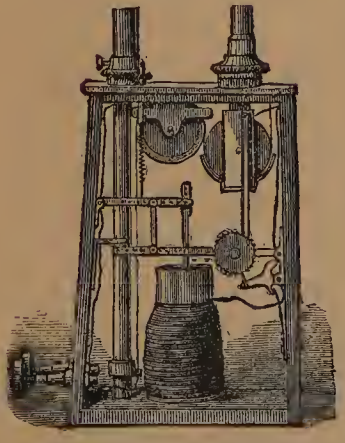

FIG. 928. *Maxim Regulator.*

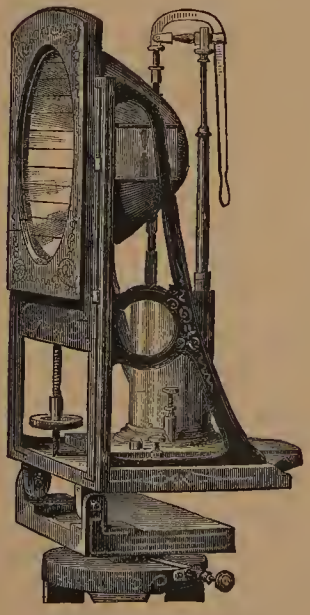

FIG. 927. *Maxim Arc Lamp.*

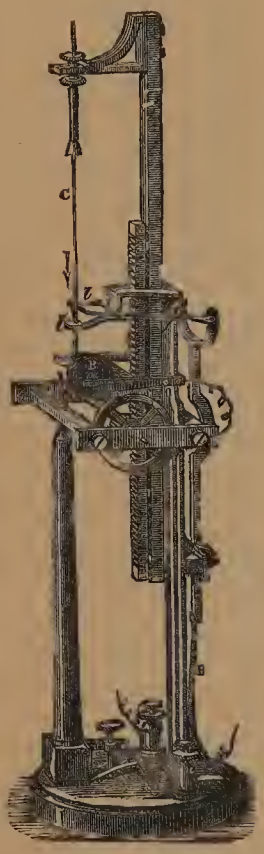

FIG. 935. *Reynier Incandescent Electric Light.*

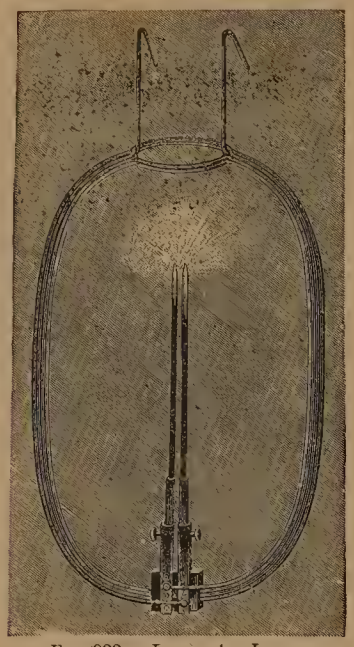

FIG. 933. *Jamin Arc Lamp.*

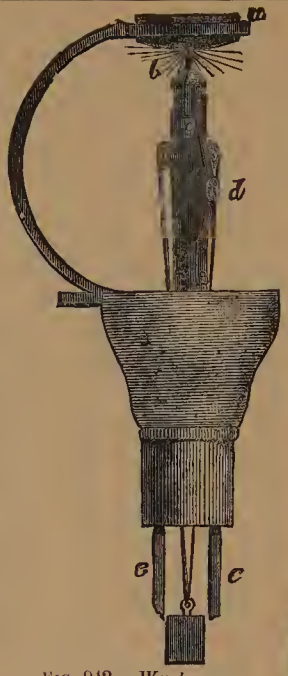

FIG. 942. *Werderman Electric Light.*

FIG. 937. *Sawyer-Man Incandescent Electric Lamp.*

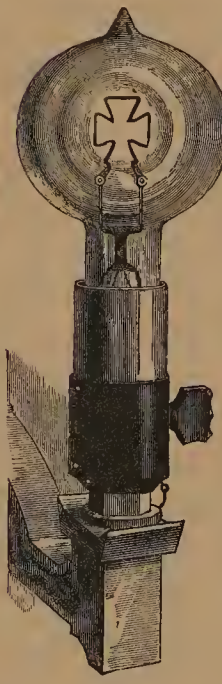

FIG. 940. *Maxim Lamp.*

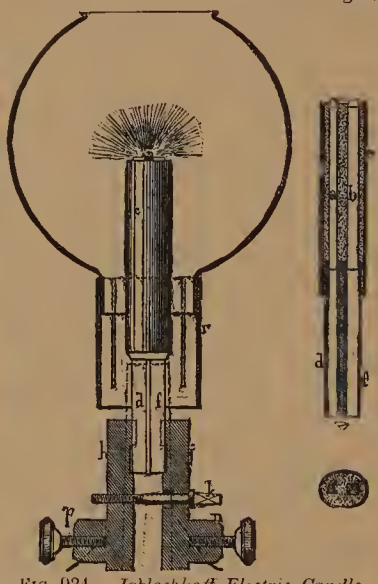

FIG. 934. *Jablochkoff Electric Candle.*

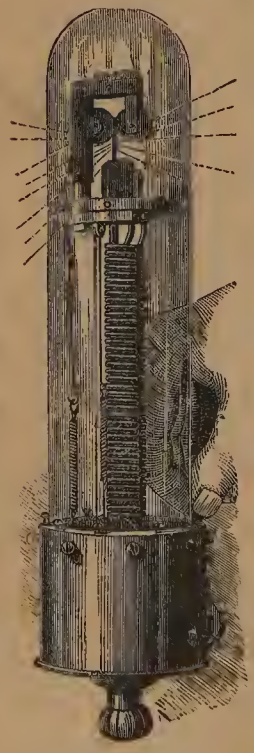

FIG. 936. *Sawyer Electric Light.*

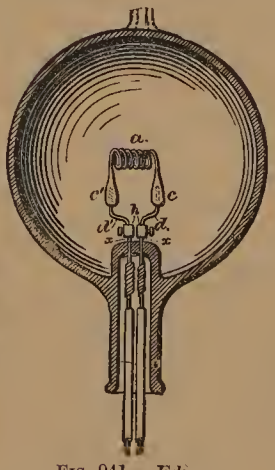

FIG. 941. *Edison Carbon-coil Lamp.*

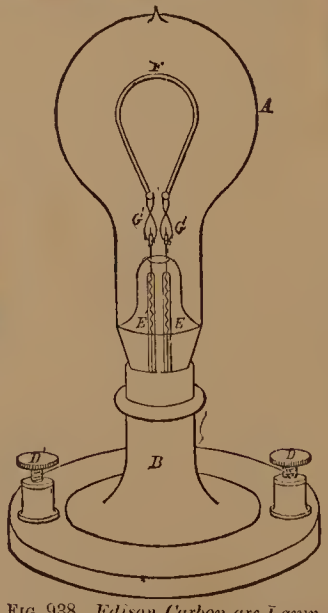

FIG. 938. *Edison Carbon-arc Lamp.*

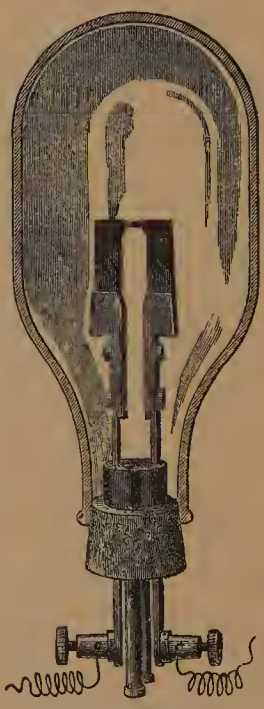

FIG. 939. *Farmer Electric Lamp.*

weight of the positive element to prevail over the upward drag of the coil-suction until the two opposing forces, gravity and magnetism, being restored to equilibrium, the normal arc-interval is reëstablished. These movements are so prompt and delicate that a sensibly uniform light is obtained.

The right-hand portion of Fig. 930, Plate XIII., shows the device for the equalization of arc electric lamps in series, and is termed the "*differential.*"

It is well known that no two arc electric lamps, employed in series, behave precisely alike. In one lamp the magnetic lift, incident to increased current-flow, takes place more promptly, and with greater facility, with a consequently greater arc-interval than in the others. Such disproportionate increase of arc-interval in one lamp necessarily weakens the current throughout the series, and thus detracts from the lifting power of all, but most so from those of the most sluggish movement. The heavier working lamps, thus dwindling in illuminative action, cease, one by one, to respond to the continually waning magnetic energy. In strong contrast with and at the expense of this enfeebled action of the weaker lamps, the arc of the most susceptible or easiest working lamp continues to expand until it practically monopolizes the effective activity of the entire circuit.

The remedy for such unequal action lies in a provision whereby — when the arc-resistance of any given lamp becomes higher than normal — the current is automatically diverted from the arc of that lamp to the next lamp of the series — or to "line" or generator, as the case may be, — to sufficiently reduce or counteract the "helix-suction" of the lamp thus regulated, to restore its arc-interval to normal length, and at the same time, by diminution of its arc-resistance, to secure resumption of normal current-flow throughout the series.

Skinner & Thomas's device for this purpose is shown in the right-hand portion of Fig. 930, Plate XIII. On the core *K* is wound a helix *S* of fine wire, which communicates from a point in the positive element (above the electrode) directly with the negative rheophore *N*, so as to shunt the arc. The portion *Q* of the differential wire, which communicates from the differential helix to the rheophore *N*, is convoluted so as to permit the free descent and ascent of the core.

By the expression "differential" is meant that the said helix *S* is so wound as to induce on the core magnetism of opposite polarity to that induced by the main helix, whose magnetism (when a current is passing through the differential), being thus more or less neutralized, operates with diminished suction so as to permit the descent of the electrode until the normal arc-interval is resumed The prime and the differential coil-magnetisms consequently preponderate alternately at each respective change of arc-interval above and below the normal one

Proper adjustment of the parts is had when the resistance of the differential is such that, in the normal condition of the arc, the magnetism induced in the core by the prime helix minus the counter-magnetism induced in the core by the differential helix just balances the surplus weight of core and adjuncts over that of the counter-balance.

By aid of this system of regulation a current can be almost indefinitely divided and the double benefit be secured of preventing excessive activity of any individual lamp, and of insuring to each lamp in the series its proper share of illuminative action. See also REGULATOR, *infra*.

The *Thomson-Houston*, Fig. 931, Plate XIII., is an arc lamp, and the invention particularly concerns the regulator.

The carbons are fed by mechanical means controlled by electro-magnetic detent in a shunt of the main circuit. One of the carbon electrodes is attached to the armature of an electro-magnet, and, on the passage of an electric current, said armature is attracted to said electro-magnet, and then held in a fixed position in respect thereto, thus effecting separation of the electrodes. The motion of the other electrode is under the control of a separate electro-magnet, whose coils are in a shunt-circuit around the arc between the electrodes When the distance between the electrodes is increased by their consumption, the shunted current operates an escapement, which allows the slow approach of the electrode. Said approach ceases when the distance between the electrodes has reached the normal. This cessation of feeding occurs when the escapement above referred to is thrown out of action from the weakening of the current in the shunt-magnet. These actions are independent of considerable variations in the current strength.

In the *Rapieff* light the voltaic arc is produced between four carbon rods arranged in pairs, each forming the letter V. The apices of the V's meet in a common center. A regulator is attached which keeps the carbons at an invariable distance. One of the carbons at a time can be detached without interrupting the current.

In the *Wallace* lamp the light is produced between the edges of two carbon plates, which last 100 hours. The edges gradually consume, and the light flies to the point where the plates are nearest in contact.

The lamps of *Wright*, 1845, *Molt*, *Lontin*, and *Reynier* embrace the plate, disk, or roller principle.

The *Wallace-Farmer* electric light is shown in Fig. 932, Plate XIII.

Like the one just mentioned, the frame carries two gas carbons, forming the electric wick. These slats are $9'' \times 3''$, the positive (upper) $\frac{1}{2}''$ thick and the negative (lower) $\frac{1}{4}''$ thick. The lower is fixed, the upper adjustable. In the absence of current the upper rests on the lower; but as soon as a current passes, the armature by which it is suspended is raised in the coil, and separates the carbons $\frac{1}{8}''$. The electro-magnet is contained in the box, and the sectional view shows clearly its construction. The arc chooses the nearest points of the carbon edges and gradually wears them away, the electro-magnet being adjusted to keep an equal distance between the nearest points of the carbons at any one time.

The *Reynier* lamp has assumed two forms, *arc* and *incandescent* respectively: the former has two carbon disks revolving in planes inclined to each other, so that the edges approach and a voltaic arc spans the interval.

The *Jamin* electric light is an arc. It has at least two nearly parallel carbons and in some cases not less than three groups of two each; one member in each case is adjustable towards its fellow. The candle has thus two vertical rods which differ from the Jablochkoff in that there is no insulating material between them. They are erected or suspended in sockets, one of which is pivoted so that a small electro-magnet controlling it can maintain automatically the proper distance between the two ends. Fig. 933, Plate XIV.

The carbon pencils are surrounded with an elliptical coil of wire, through which passes the current that gives the light. The coil is in the same vertical plane as the carbon rods. A more elaborate arrangement is shown in "*Plumber & Sanitary Engineer*," * iii. 400.

The *Weston* is an arc light, having two erect nearly parallel carbon rods, the positive twice the bulk of the negative. They are supported in sockets, the negative being pivoted so that its upper end can be adjusted towards and from the positive, towards which it is inclined by a spring. As soon as electric connection is made, the armature of an electro-magnet withdraws the movable carbon from contact and the voltaic arc is established.

Jablochkoff's invention is an electric candle: his object is the "absolute suppression of any mechanical regulator." Instead of automatically feeding them towards each other he fixes them parallel at a short distance from each other and separates them by an isolating substance which is consumed at the same time with the carbons. Fig. 934, Plate XIV.

The separating substance is an earthy infusible powder put around the carbons in a closed envelope of asbestos. The electric stream gradually dissipates the intractable substance, clearing it away from the carbons and exposing them, somewhat as the wick of a candle is exposed by the burning away of the tallow.

a b are the carbons, *e* the asbestos case, *d f* metallic sheath, *h j* jaws, *k* tightening screw, *p n* terminals.

The *Lontin* lamp and the *Reynier* keep a slender rod of carbon in contact with a slowly revolving wheel, touching it on the outer rim and keeping a certain length of the rod incandescent.

The *Reynier* lamp, Fig. 935, Plate XIV., has a slender pencil of carbon, *c*, which is traversed through a portion of its length by the current (from *l* to *B*), and is impelled axially against a revolving contact which carries off the ashes of the carbon. The portion of the pencil between the upper contact *l* and the lower revolving contact *B* becomes incandescent, and burns, tapering away towards the end, the rod being continually fed forward.

Kosloff's (1875) is an incandescent light, the current passing through sticks of carbon in a globe filled with nitrogen gas, the carbon is mounted on an inserted metallic conductor and placed between two insulating supports of porcelain, clay, or other material. The carbons are in a globe, hermetically sealed, filled with nitrogen gas.

In the *Sawyer* electric lamp the feeding of the carbon pencil to the contact piece is effected by a spring and cord running over pulleys. The pencil of carbon is heated to incandescence in a hermetically sealed glass globe filled with nitrogen gas or exhausted of air. The summit of the upper carbon is pressed between grooved rollers. The base of the lamp-globe is imbedded in a cup having an annular space, and the base of the lamp is in two sections, for facilitating the renewal of the carbon. Fig. 936, Plate XIV.

The *Sawyer-Man* is an incandescent lamp. The incandescent strip is automatically fed through one conductor and against another, the part between the two conductors giving a light. The two conductors are supported by spiral standards, the length and extent of surface serving to dissipate the heat and thus preserve the insulation. The whole is incased in a glass globe filled with nitrogen. Fig. 937, Plate XIV.

Edison's carbon-arc lamp is an incandescent lamp. The arc *F* is attached by clamps *G G'* to the platinum wires *W*, which are sealed in the summit of the interior glass dome. At

a lower point is an enlargement *E E'* upon which sits the lower end of the tube, the upper portion of which is the device *A* around the incandescent arc. The patent No. 230,255 particularly concerns the mode of sealing the wires in the foot, and the mode of exhausting and sealing the dome, to secure entire freedom from oxygeu in the interior. *B* is the pillar of the lamp and *D D'* binding posts for the wires. Fig. 938, Plate XIV.

In one form of the carbon arc lamp the carbons are of slips of paper or cardboard cut to horse-shoe shape and charred, then mounted by platinum clamps on the sealed wires.

One of *Edison's* regulators is an automatic shunt fitted to the lamp, by which a portion of the current is diverted from the circuit of the light producing portion of the apparatus whenever its temperature approaches an injurious limit.

Edison's expansion, pneumatic, and vibratory regulators are described, illustrated, and compared in an article by F. R. Uptou, in "*Scribner's Monthly*," vol. xix., pp. 531-544.

In another of *Edison's* electric regulators he makes use of a coil of wire with a pyro-insulating material between the coils, and a surrounding case rendered incandescent by the heat of the coil. In the same lamp, which is adapted to be used in multiple arc, a thermal circuit is arranged so that the amount of light can be varied at pleasure by an adjusting-screw that regulates the point at which the thermal regulator acts to open the electric circuit and lessen the current, so that the incandescent case can be more or less luminuous. The claim for a thermostatic regulator is, however, held by *Maxim* in his patent, No. 247,380, Sept. 20, 1881.

Edison's safety device, for preventing an abnormal flow of current through any branch, consists of a piece of very small conductor interposed in the main conductors of a house or in the derived circuit of a lamp. It is preferably interposed between the line wires and every lamp, limiting to the latter the amount of current designed for it.

Farmer's is an incandescent lamp, the globe of which eontains a vacuum, or an artificial atmosphere — say nitrogen. From the stopper of the globe rise two uprights, between which is held a removable carbon slip, which, upon passage of the current, becomes incandescent. Fig. 939, Plate XIV.

The *Maxim* is an incandescent lamp, the light being produced by a strip or conductor of low conductivity, forming a part of the electric circuit. Fig. 940, Plate XIV.

The illumination takes place in a glass chamber deprived of oxygen, but instead of excluding the air by exhaustion, or filling the globe with nitrogen, the air is displaced with a hydro-carbon, preferably gasoline, and such liquid then expelled by heat, so as to leave in the globe a hydrocarbon partial vacuum, or a highly-attennated atmosphere of hydrocarbon vapor surrounding the conductor or light-giving part of the lamp. The continuous incandescent conductor is mounted upon electrical connections of platinum.

Edison's carbon coil lamp is an incandesceut; a filament of carbon either in arc or coil shape, that is, of "carbon wire or sheets coiled or arranged in such manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation may take place."

The electricity is conducted into the vacuum bulb through platinum wires sealed in the glass.

In Fig. 941, Plate XIV., *a* represents a carbon coil attached to platinum conductors *d d'* by a plastic composition of lampblack and tar. *c c'*, *h* are clamps.

Kholinsky (French patent, No. 107,307, of March 19, 1875) shows an incandescent carbon lamp, having in its base resistance coils and a switch whereby the current can be passed wholly through the carbon or wholly through a resistance equal to the resistance of the carbon, or if a partial light is desired, then partly through the carbon and partly through a resistance, the arrangement being such that the total resistance is always equal to a certain amount. The current is shifted automatically to another carbon in same lamp when one breaks.

The *Werdermann* lamp has a vertical rod of carbon which impinges at its upper end upon a disk of carbon, Fig. 942, Plate XIV. The upper end of the rod becomes incandescent, and a voltaic arc is also formed.

The upper part only of the carbon rod is in the circuit, and the length of this portion can be increased or diminished by shifting the collar which transmits the current. The rod is kept pressed against the disk by a cord and weight, and consumes very slowly. The disk is negative; 2″ in diameter, 1″ thick, encircled by a band of copper, which is prolonged to a terminal. The positive carbon is a round pencil 3 mm. in diameter, and slides in a tube.

"Dr. Tyndall and Mr. Douglass, chief engineer to the Trinity Board, in reporting lately to the Elder Brethren upon the power of these machines and their applicability to lighthouses, give a table showing that a machine weighing not more than 3 cwt. is capable of producing a light equal to 1250-candle power per horse-power expenditure of mechanical energy. Assuming that each horse-power is maintained with an expenditure of 3 lbs of coal per hour (which is an excessive estimate), it would appear that 1 lb. of coal suffices to maintain a light equal to 417½ normal candles for one hour. The same amount of light would be produced by 139 cubic feet of gas of 18-candle power, for the production of which 30 lbs. of coal are consumed. Assuming that of this quantity, after heating the retorts, etc., 50 per cent. is returned in the form of gas-coke, there remains a net expenditure of 15 lbs. of coal in the case of gas-lighting to produce the effect of 1 lb. of fuel expended in electric lighting, or a ratio of 15 to 1 in favor of the latter. Add to the advantages of cheapness in maintenance, and of a reduced capital expenditure in favor of the electric light, those of its great superiority in quality and its freedom from the deleterious effects of gas in heating and polluting the atmosphere in which it burns, and it seems not improbable that it will supersede before long its competitor in many of its applications." — *Dr. C. W Siemens*, Address, January 23, 1878.

The annual report of the United States Light-house Board contains the details of some recent tests with electric lamps, made at the Stevens Institute of Technology by Prof. Morton. The results of these experiments are embodied in the following table, in which the term hand-lamp is employed to signify that the distance between the carbons was regulated by hand: —

Machine.	Lamp.	Average Candle Power.	Average Horse Power.	Average Candle Power per Horse Power.
Maxim (ordinary type)	Maxim . . .	3,297	5.483	729
Maxim	Hand lamp .	3,930	5.585	704
Siemens	Siemens . .	4,651	4.863	956
Siemens	Siemens . .	4,548	4 742	959
Weston	Hand lamp .	8,585	4 769	1,800
Weston	Maxim . . .	7,787	4.683	1,663
Weston	Siemens . .	7,262	5 056	1,436
Weston	Weston . . .	6,063	4.552	1,332
Maxim (with magnets of low resistance) . . .	Maxim . . .	7,524	7.400	1,017
Brush	Brush . . .	4,365	2.8467	1,533
Brush	Siemens . .	3,532	2.9573	1,194

The results of the attempts at the "Division of the Electric Light," may be divided into four classes, *series*, *multiple arc*, *multiple series*, and the *commutator system*.

The *series* system, *i. e.*, with the lamps all arranged in succession in one unbranched circuit, was the first one employed, and is still found to be the best when are lamps are used.

In the *multiple arc* system the conductor is divided into numerous branches, in each of which is placed one lamp. Two main conductors are run out from the generator and divided and sub-divided while still remaining in pairs, and at various points the lamps are connected so as to bridge the said pair. A ground return is sometimes substituted for one of the conductors. The first mention of multiple arc lighting appears in du Moncel's "*Exposé des Applications de l'Electricité*," Paris, 1857. It has the advantage over the series system, that the extinguishment or breakage of one lamp does not materially affect the others, but as all the lamps are in parallel branches the total external resistance is exceedingly small, and for this reason the system is more particularly adapted for incandescent lamps which are made of such high resistances as 100 and 200 ohms on that account.

The *multiple series* system is a combination of the first and second. The circuit is divided as in the multiple arc, but more than one lamp is placed in each branch, so that the resistance may be made such as desired. This system seems to have been first described in a patent to Sawyer and Man, 205,303, June 25, 1878. *Brush* (patent, No. 261,077, July 11, 1882) shows and claims a multiple series system, in which the different branches are connected by cross connections between the lights in such a manner that the breaking of circuit at one lamp will have no appreciable effect on any of the other lamps in the system.

In the fourth system a *commutator* is employed which so divides the current among different branch conductors each having one or more lamps, that each lamp is traversed by the current for a small fraction of a second. By means of a sufficiently rapid commutator the impulses to each light follow each other in such quick succession as to give the effect of a continuous light.

Secondary batteries were described by Jablochoff in his French patent of 1876, as in a branch or shunt around each light. Fox, in his English patent of 1878, shows a network of conductors between which and the ground return are connected up in multiple arc incandescent lamps and secondary batteries.

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E-lec'tric Light Meter. An invention of Edison for measuring the quantity of electric current passing to a light or to a house. A part of the system of divisional current arrangement for public lighting.

The current goes from line by the house-wire to the apparatus, passing through two contacting platinum points and thence to a magnet. The device is to cut a house out of the circuit if too great a flow of electricity should occur. In the latter case the magnet will draw down a lever and sever the contact of the platinum points, thereby breaking the circuit.

E-lec'tric Light Reg'u-la'tor. An apparatus or device: —

1. To determine the amount of current passing to the electric lamp.

2. To adjust the carbons of the arc light so that they shall preserve their exact relative distance.

Of these there are two orders: —

a. The *monophote,* or *one-light* regulator.

b. The *polyphote, many light,* or *division* regulator.

The *polyphote* has three classes: —

a. Differential.

b. Derivation.

c. Fixed interval, or regulator *à écart fixe.*

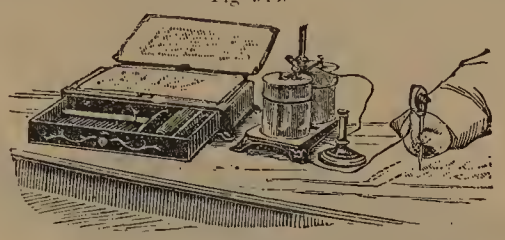
The *Serrin,* Mersanne,* Jablochkoff, Lontin, Rapieff* regulators are described on pp. 362-365, "*Engineering,*" xxvi., in a paper read by Mr. Shoolbred before the British Association at the Dublin meeting, 1878.

See also list under ELECTRIC LIGHT. Many of the objects there cited are *regulators,* as upon that feature of the apparatus more ingenuity has perhaps been expended than on other — excepting *generators.*

E-lec'tric Meas'ure-ment Ap'pa-ra'tus. An apparatus consisting of a box of graduated or cumulative resistances, and a galvanometer for determining the electro-motive force, resistance and strength of batteries, and resistance of conductors: for locating faults, breaks, and crosses on telegraph lines or cables; for measuring the amount of any metal deposited in a given time in electro-plating; and for determining the specific conductivity of metals.

E-lec'tric Pen. The electric pen consists of a small electro-magnetic engine, mounted upon the top of a tube pointed at the end. Within the tube is a needle to which is given an exceedingly rapid vertical motion by cams upon the rotating engine-

Fig. 943.



Edison's Electric Pen

shaft. This needle is projected from the small end of the tube at the rate of 50 times per second. If the pen be held in writing position upon a sheet of writing paper placed on some soft substance, a letter may be written as fast as with an ordinary pen, but the characters, unlike the ink mark formed by the ordinary pen, will be composed of innumerable holes punctured in the paper by the rapid projection of the needle from the tube. The result is a perforated paper, which, treated as an ordinary stencil, will give similar result. The motive power used to drive the engine of the pen is derived from a voltaic battery of two Bunsen cells, shown in Fig. 943.

See references: —
Edison . * "*Engineering,*" xxii. 511.
"*Technologiste,*" xli. 544.
"*Manufacturer & Builder,*" xi. 38.
* "*Mining and Scientific Press,*" xxxvii. 89.
* "*Jour. Society Telegraphic Engineers,*" v. 180.
Scott, Eng. * "*Scientific American,*" xl. 121, * 408.

E-lec'tric Pho-tom'e-ter. Goodwin's electric photometer extinguishes candle and gas, and stops meter and clock by electricity.

"*American Gas-light Journal*" . * July 3, 1876, p. 5.

E-lec'tric Plow. A substitution of a dynamo-electric machine for the steam traction-engine, for the purpose of working the plows. The same arrangement of plow, rope, and installation is used (see STEAM PLOW, "*Mech. Dict.*"), but the power is conveyed to the winding drum on the head-lands of the field by wire from the central station where the engine, boiler, and current generator are situated.

The apparatus was invented by Chrétien & Félix, of Sermaize (Marne), France. The Gramme machine is used.

* "*Revue Industrielle.*"
* "*Engineer*" . . . . . xlvii. 434.
* "*Scientific American*" . . . . . July 17, 1879

E-lec'tric Rail'way. The car travels on insulated rails which form a part of the circuit, and the current works the dynamo machine on the car to rotate the wheels.

Siemens' electric railway at Berlin, between the suburbs Lichtenfeld and the Cadettenhaus, is one and a half miles long with a gage of 3′, the rails of the ordinary pattern. A single car is propelled at 9 miles per hour, but might travel much faster; the car holds 20 persons; the dynamo machine is under the car; one rail positive and the other negative. The dynamo machine transmits its movement to the wheels by spiral steel springs. In addition to the ordinary brakes, means are provided to short circuit the machines on the carriages and to cause them to act as powerful brakes. Large stationary engines are used.

In the earlier experiments a central rail brought the current from the generator, the current returning by the outer rails A copper brush on the car collected the current from the central rail. Several forms have been assumed from time to time. See references, *infra*

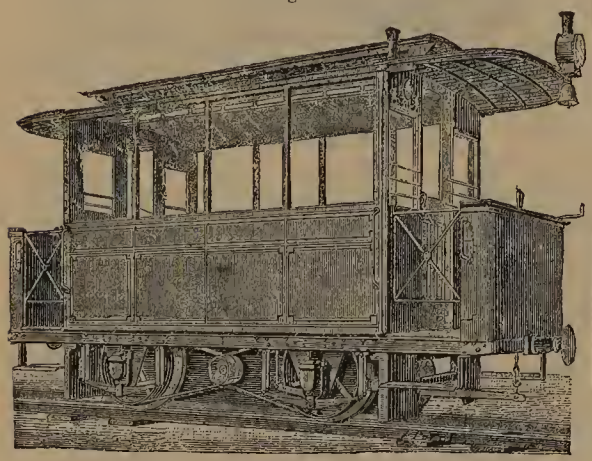
Chutter's engine, "*English Mechanic*," has also the feature of the positive and negative rails.

"*Scientific American Supplement*" . . . . . * 301.

The attention directed to the matter has unearthed a number of old devices. The *Lilly & Colton* electric locomotive described in the "*Scientific American*" for Sept. 25, 1847; *Bone's* French patent, 1848.

The *Edison* railway has a current conveyed to the track by two copper wires, one for each rail. The armature of the locomotive makes 4 revolutions for one of the wheel.

Fig. 944.



Gross-Lichterfelde Electric Railway Car.

There are six systems of electric traction at present in use, or being experimented with, namely: —

1. The small traction machine of Siemens with an isolated center rail, which was worked at the Berlin and Brussels Exhibitions.

2. A self-moving carriage on isolated rail and elevated road. This is an idea of Siemens, which has been temporarily abandoned.

3. The Gross-Lichterfelde Railway. An auto-mobile car with isolated rails, running since May 16, 1881.

4. The tramway shown at Electric Exposition in Paris, 1881. Auto-mobile car, with road on ground level, and conductor suspended above the way.

5. Electric tramway with accumulators. System of Philippart, Faure, and Reynier, Auto-mobile car having in it its own electric store.

6. The tricycle built by M. Trouvé. It is worked by the secondary piles of Gaston Planté, and by a Siemens' coil motor with Trouvé's improvement

Car, *Siemens*	* "*Engineering*," xxix. 487.
Locomotive, *Chutter* . .	* "*Scientific American Sup.*," 301.
Railway, on, *Edison* .	"*Van Nostr. Mag*," xxiii. 515.
Siemens & Halske . .	"*Telegraphic Journal*," vii. 222.
Siemens . . .	* "*Manuf. & Builder*," xii. 228.
	* "*Sc. Am. Sup.*," 3743, * 3850.
Edison	* "*Manuf. & Builder*," xii. 123.
	* "*Sc. American*," xlii. 354, 368.

E-lec'tric Reg'is-ter. An automatically recording apparatus in which electricity is the moving agent.

The applications are very numerous, and a number are stated in the list following.

Cooley's electric register for rapid vibrations is an electrochemical instrument in which the vibrating body closes an electric circuit at each vibration and makes an autographic record on a traveling band of prepared paper, through which the current is caused to pass. The number of dots within a given length of the paper, which travels at a calculated speed, indicates with great delicacy the number of vibrations in a given time. — * "*Scientific American Sup.*," 1563.

Various forms of electric registers are to be found in *Comte du Moncel's* "*Exposé des Applications de l'Électricité*," tome iv., Paris, 3d edition, at the pages here noted: —

		Page.	Figure.	Plate.
Anemographs, History of		303		
Anemograph	* *du Moncel* . .	305	1-3	VIII.
		305	58-61	
	* *Salleron* . . .	325	62-67	
Anemograph . . .	*Hervé Mangon*	329		
	* *One wire* . . .	331	68	
	* *Hardy* . . .	332	69-71	
	Hough . . .	340		
	* *Wheatstone* . .	342	14	VI.
Anemoscopes		343		
Anemoscope	*Yates*	344		
Barometrograph . .	* *Hardy*	352	15	V.
	* *Hough* . . .	354	72	
	Riatti	359		
Barometrograph et Thermometrograph .	*Hipp*	358		
Distance Measurer . .	* *du Moncel* . .	422	85-88	
Electr. Phys. Registers	* *Boeck* . . .	437	91	
Flexion Registers . .	* *Marqfoy* . . .	441	92	
Galvanomerograph .	*Régnard* . . .	445		
Mareograph	*du Moncel* . .	430		
Max. & Min. Register	*Luais*	364-7	15	VI.
Melodiograph . . .	* *du Moncel* . .	446	93-95	
Melograph		452		
Meteorograph . . .	*Bertelli* . . .	373		
	Guiot	351		
	* *Hough* . . .	392	84	
	Régnard . . .	350		
	Schubart . . .	412		
	* *Secchi*	381	74-83	
	* *Theorell* . . .	402	2	VIII.
	* *Van Baumhauer*	420		
	Van Rysselberghe	408	3-6	VIII.
	* *Wheatstone* . .	371	12	VI.
	Wilde	396		
Oscillograph	*Bertin*	435		
Reservoir depth reg'r .	*Deschiens* . .	431		
Seismograph	*Palmieri et al.* .	367		
Thermometrograph .	*Morin*	352		
	Wheatstone . .	346		
Udometrograph . . .	* *Salleron* . . .	362	72	
Viameter (navy) . .	* *Bain*	433	89	

See also in lists, GRAPH, METER, SCOPE in "*Mech. Dict.*," and list under MEASURING, ETC., INSTRUMENTS, *infra*.

E-lec'tric Ro-ta'tor. An instrument operating through electrical devices to demonstrate the earth's rotation.

Fouville & Lontin . * "*Scientific American*," xliii. 52.
* "*Sc. American*," xxxix. 1, 37, 100.

See also GYROSCOPE, p. 1045, "*Mech. Dict.*," and references to Foucault's Pendulum, pp. 1045 and 1662, *Ibid.*

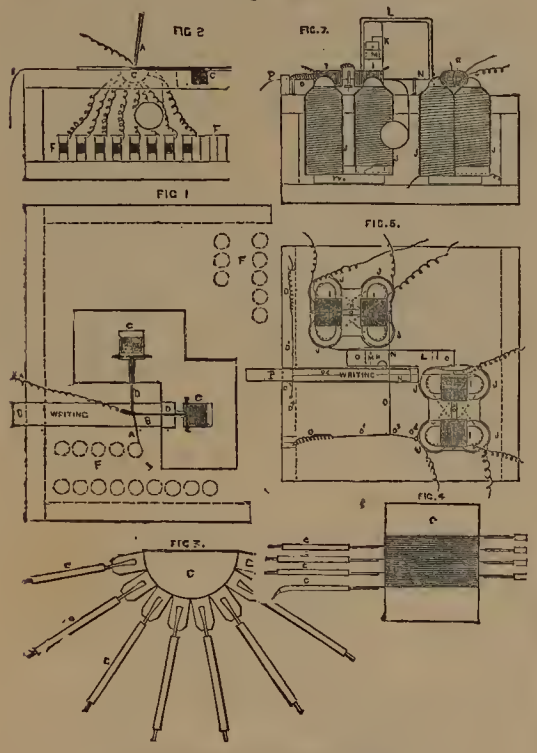
E-lec'tric Switch. A device for turning on the current to lights, etc., which gradually changes the current from an outside path to a path through the light by cutting out successively resistances in the lamp circuit and simultaneously cutting in resistances in the by-path circuit.

E-lec'tric Writ'ing Ap'pa-ra'tus. The autographic telegraph of *Caselli* is described on p. 191, "*Mech. Dict.*," and the Meyer apparatus, * p. 56, *supra*. Sawyer's and d'Arlincourt's, are also referred to on the last-mentioned page. Bonelli's facsimile telegraph is mentioned on p. 784, "*Mech. Dict.*" See also FACSIMILE TELEGRAPH; PANTELEGRAPH, *infra*.

Fig. 945 shows several views of Cowper's apparatus. Fig. 1 in the cut represents the sending instrument in plan, and 2 is an elevation of the same. The writer holds the pen, which is rigidly connected to the traveling contacts, and also to the batteries. The slip of paper on which the message is written moves under the pen instead of the pen traveling over the paper.

"Two sets of thin metallic plates, C C, form the contact apparatus; D D are the light connecting rods, the ends of which make contact with the plates; F F are the resistance coils connected to the contact plates, one coil for each plate, except the first of the series, which is connected direct to line. It will be noticed that the strength of the current entering the line depends upon the plate with which contact is made by the connecting rod. As the rod travels from the first of the series the resistance increases, the current having to pass through N — 1 resistance coils, as well as the line wire, N being the number of plates from the first of the series to the point at which contact is made. Generally, however, as one contact piece travels from the first of the series, the other travels towards the first of its series, and thus, while the current decreasingly varies in one line, the varia-

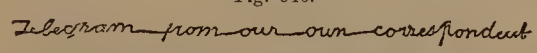
Fig. 945.



Cowper's Electric Writing Apparatus.

tion is increasing in the other. A slight knowledge of co-ordinate geometry will enable the student to plot the curve of any letter, and to calculate the variations in the strengths of the currents. Figs. 3 and 4 show respectively an eleva-

Fig. 946.



Written Message by Cowper's Instrument.

tion and plan of the thin metal plates, which are insulated the one from the other by paper soaked in paraffine. The receiving instrument, shown in plan and elevation in Figs. 5 and 6, differs from the sending instrument; H H are light soft iron bars on delicate bearings, having the ends surrounded hy the coils I I, to which the bars form a movable core. Through these coils the varying currents of the line are sent, which, of course, have a varying action on the core. J J J J are four permanent or electro-magnets, between the poles of which the coils just named are placed; K is a syphon pen. The pen is adjustable from the bridge L, and the ink reservoir is shown at M. The light connecting rods N N transmit the motions of the movable cores to the pen; O O are springs to enable the pen to resist the pull of the magnets, the connections are showu in O^1 O^2 O^3, the latter being attached to a fixed post O^4.

"The currents sent through the line wire by the sending instrument vary in strength or power, and cause the light bar of soft iron to move with varying power by its attraction to the stationary magnets; and in order to cause it to take its proper position according to each variation in power, a varying resistance is opposed to it, such as a spring which requires more power to compress it the more it is compressed, that the action of the soft iron bar, combined with that of a precisely similar bar actuated by the second line wire, will cause the position of the pen in the receiving instrument to follow the position of the pen in the hand of the operator at the sending instrument, and thus form the letters. The total strength of the spring or varying resistance can he regulated at will, so that the letters formed by the pen shall be of the same proportionate height and width as the letters written hy the operator at the sending instrument. One convenient way of applying the varying resistance to the light bar of soft iron is by placing a very light spring to pull at the end of the har in the direction of its length, but allowing of the motion of the bar which will thus cause the spring to act with more and more leverage as it moves more out of line with the spring. When so arranged there is required another spring to keep the connection with the pen tight, if such connection is flexible, so that the pen may go backwards as well as forwards over the paper, as the light bar of soft iron moves either one way or the other. But the spring or variable resistance may be made to act both to give the increasing resistance and the power to draw back the pen as well, if the spring is made to pull by a flexible or jointed connection at a fixed point, the line of such pull being parallel, or nearly so, to the light bar of soft iron, while another rigid or flexible connection from the end of the bar to the connection to the spring has the pen attached to it at about the middle of its length, which arrangement will give the same result as the two springs before described."—"*Engineering.*"

E-lec'tro Bal-lis'ta. An apparatus for measuring the rapidity of flight of a shot. See BALLISTA. Electro-ballistic pendulum, "*Mech. Dict.*"

In *Boulengé's* apparatus the shot is made to break through two wire screens. The screen is a framework with fine wires, which are cut hy the shot. One screen is near the muzzle of the gun, and the other at 100′ distance. The screens are in connection with electro-magnets in the instrument house. While the wires in front of the screen are perfect, an electric current passes without interruption, and the electro-magnets suspend two rods of iron. When the shot is fired, No. 1 screen is torn, and the rod suspended to No. 1 magnet drops; an instant afterward, when the shot has reached No. 2 screen, No. 2 magnet detaches the second rod. The time between the falling of the two rods is so small, that ere the first has fallen half its length the second has dropped upon a trigger, which strikes the side of No. 1 rod. The latter is examined for the mark of the trigger, and the measure of this mark from the end, giving the distance traversed by the first detached rod, the rate being known, furnishes a figure which has only to be compared with a prepared scale in order to read off the number of feet per second at which the shot moved.

E-lec'tro-bronz'ing. A process for putting on iron a durable electro-bronze finish, resembling real bronze.

The articles to be bronzed are first put in a bath of paraffine, which stops further oxidation; they are then coated with a metallic substance and subjected to the electro-bronzing bath, after which they are treated with a peculiar protecting varnish, and are then ready for use.

E-lec'tro-cap'il-la-ry Mo'tor. A philosophic toy by M. Lippmann, founded upon the effect produced upon the capillary constant of mercury when an electric contact is made therewith.

In a glass tank filled with diluted sulphuric acid are two small cylinders containing mercury. A bundle of capillary tubes, open at both ends, is placed in each cylinder, resting on the mercury, each bundle being connected above with one end of a walking beam, to the prolongation of which is attached a connecting rod, crank, and fly-wheel. By means of a commutator on the axis of the fly-wheel the mercury in each cylinder is alternately connected with a small battery; its capillary constant is changed, its ascent in the tubes increased, that side preponderates, and causes semi-rotation of the fly-wheel. This sends the current to the other cylinder, which, acting similarly, completes the rotation.

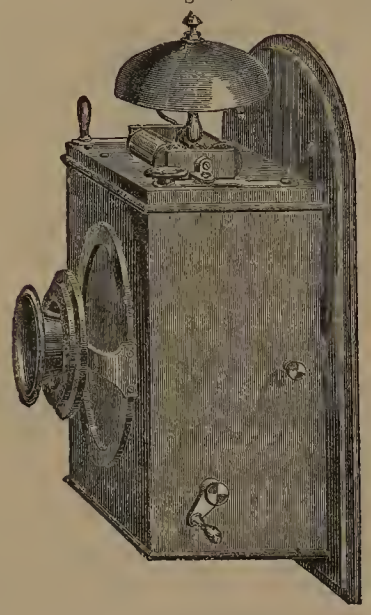
E-lec'tro-cau'te-ry. (*Electricity.*) See CAUTERY INSTRUMENT.

E-lec'tro-chem'i-cal Tel'e-phone. A telephonic receiver by Edison, in principle similar to the electro-motograph, which see.

If a strip of bibulous paper, slightly moistened with a weak solution of potassium hydrate, be laid upon a strip of metal, which by means of a key or contact maker can be connected to one pole of a voltaic battery, and a metallic strip, tipped with platinum, and connected to the other pole of the battery, be gently drawn over the surface of the paper, it will encounter a resistance, the amount of which, all other things being equal, will be determined by the coefficient of friction between the platinum-tipped spring and the surface of the moistened paper. The instant, however, that the circuit is closed by depressing the key, the friction between the two surfaces is reduced, and assuming a uniform tractive force to be exerted upon the strip, it will be found to slip over the surface of the paper every time that the key is depressed; and if the key be moved up and down, a series of pulsations or minute jerks will be felt by a person holding the strip, which pulsations are isochronous with the movements of the key.

The instrument shown in Figs. 947–950 consists of a diaphragm which is set into vibration by the variations of friction taking place between a metallic strip and a chemically prepared rotating cylinder under variations of the strength of an electric current passing at the point of contact of the metallic strip and the cylinder. The diagram, Fig. 949, shows the disposition of the principal parts of the

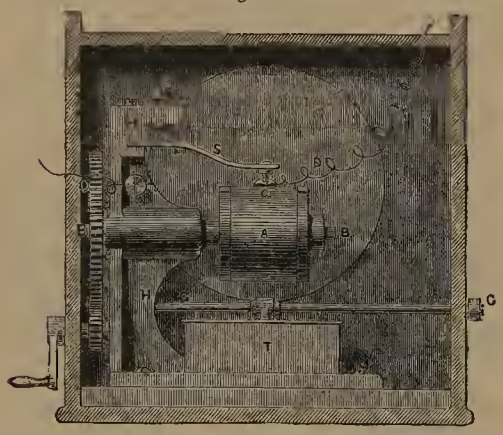
Fig. 947.



Electro-chemical Telephone.

apparatus. *A* is a cylinder composed of chalk and potassium hydrate with a small quantity of mercury acetate molded round a flanged roller or reel of brass which is lined with platinum on those surfaces which are in contact with the mixture, which is kept in a moistened condition. Upon the upper circumference of the cylinder, which is caused to re-

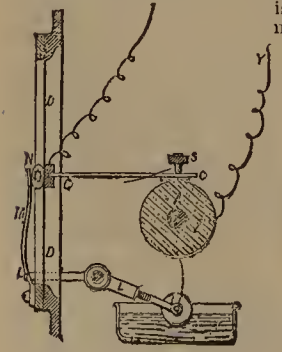
Fig. 948.



Electro-chemical Telephone. (Vertical Section.)

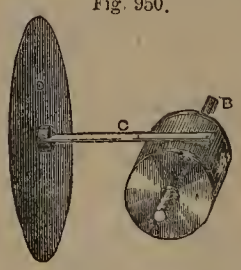
volve on the horizontal spindle *B B*, a metallic strip *C* is caused to press with a firm and uniform pressure by means of an adjustable spring, *S*. The portion of the strip which bears upon the cylinder is lined with platinum, and the opposite end is attached to a diaphragm, *D*, of mica 4″ in diameter, and firmly fixed by its circumference. The cylinder is connected to the copper element of a battery, and the strip

Fig. 949.



Electro-chemical Telephone. (Sectional diagram.)

Fig. 950.



Electro-chemical Telephone. (Detached view of diaphragm and roller.)

C to the zinc pole, with a transmitting telephone included in the circuit. If, when no current is passing through the instrument, the cylinder be rotated at a uniform speed away from the diaphragm, the friction between the cylinder and the strip *C* causes the diaphragm to be drawn inwards, *i. e.*, towards the cylinder, and the diaphragm would take up a fixed position dependent upon its own rigidity and the friction between the cylinder and the strip. The instant, however, that a current is transmitted through the instrument that friction is reduced and the diaphragm flies back by its own unopposed elasticity, the variation of friction being proportional to the variation of the strength of the electric current; and so extremely sensitive is this combination that the variations in the strength of the electric current caused by the human voice speaking against a carbon transmitting telephone instantly produce their corresponding variations of friction, and the diaphragm repeats the words, but very much louder than they were originally uttered at the distant station.

Of the other parts: *H H* is the cast-iron bracket holding the principal parts of the apparatus. *G* is a shaft by which the forked lever *L* may be raised occasionally to bring the damping roller *R* from the trough *T* against the roller *A*.

"*Engineering*" . . . . . * xxvii. 239.

E-lec'trode. (*Electricity.*) 1. A pole of a battery.

2. An instrument used in the application of electricity usually attached to the free extremities of conductors or cords. Sometimes called *rheophore.*

3. (*Surgical.*) Electrodes for various applications in electro-therapeutics are made of shapes appropriate. Among them may be mentioned: —

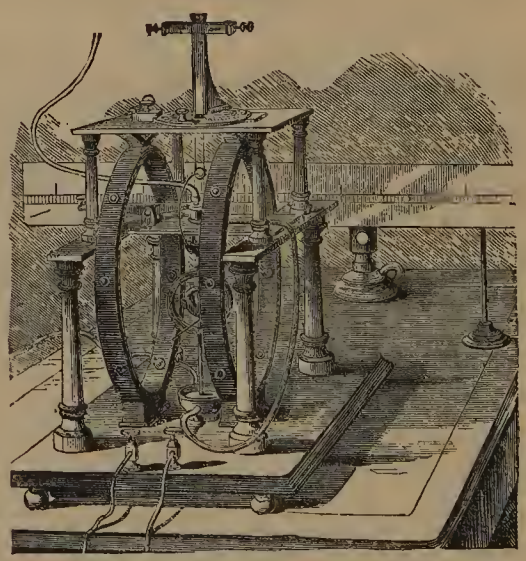
Plates for the feet, throat, temple, ankle.
Belts for the waist, wrist, arm, leg, knee, etc.
Insulated for rectum, vagina, urethra, bladder.
In form of needles, pessaries, forceps, plugs, balls, plates, sponges, brushes, pads.

50 forms are shown in the catalogue of the "*Western Electric Manufacturing Company.*"

4. One of the carbons (in some cases metal) in the arc electric light.

E-lec'tro-dy-na-mom'e-ter. A measurer of the force of an electric current.

Fig. 951.



Electro-dynamometer.

The electrical current traverses the two large spirals of copper ribbon, and also the smaller spiral, whose bifilar suspension keeps it at right angles to the larger spirals when no current passes. The smaller spiral carries a small mirror, and the readings are taken from a distant scale, the light spot serving as an index. The circuit is completed through the smaller spiral by means of mercury cups kept cool by water running through their hollow walls.

Invented by Trowbridge and improved by Edison.

E-lec'tro Gild'ing. See ELECTRO PLATING.

E-lec'tro-graph. An instrument used for engraving the cylinders of copper or brass employed in the printing of woven fabrics and paper-hangings. Voltaic electricity is used to communicate the necessary movements in advancing the cutting tools at the appropriate times.

The cylinder to be engraved is first coated on its outer surface with a film of varnish. The required number of copies are then scratched through the ground by a series of diamond points arranged on the axis of the machine parallel with the axis of the cylinder. The metallic surface is thereby exposed in certain parts and is "bitten in" with acids. Each diamond point is in connection with a small temporary magnet, and the entire series is so arranged *en rapport* with the original design, that intermittent voltaic currents are established, which result in the diamonds being withdrawn from action at proper intervals.

E-lec'tro-har-mon'ic Tel'e-graph. An invention of Elisha Gray, of Chicago, by which numerous musical tones or a number of messages may be sent by telegraph simultaneously, on a single wire.

Figs. 6265-6269, pp. 2516-2518, "*Mech. Dict.*"
Gray . . . . . "*Iron Age*," xvii., Ap. 13, p. 3.
Papers by *F. L. Pope* . * "*Sc. Am. Sup.*," 2088, 2097.
* "*Jour. Soc. Tel. Eng.*," vii. 356.

E'lec-trol'y-sis. (*Electricity.*) The process of resolving compound substances into their constituent elements by voltaic action.

Keith's apparatus . . * "*Engineering and Min. Jour.*," xxvi. 26, 37, 59.

E-lec'tro-mag'net. See under the following references: —

Magnets, *Bessin* . . . . . "*Sc. Am.*," xxxix. 104.
Faulkner . . . . . "*Sc. Am. Sup.*," xxxii.
forms of . . . . . * "*Sc. Am. Sup.*," 2897-2899.
Penning . . . . . * "*Telegr. Jour.*," iv. 139.
Paper by *Trowbridge* . . . "*Sc. Am. Sup.*," 367.
Electro-mag. engine, *Camacho* . * "*Sc. Am.*," xxxv. 310.
engine motor, *Deprez*, Fr. . "*Iron Age*," xxiv., Aug. 7, p. 15.
Egges, Austria . . . . . * "*Sc. Am. Sup.*, 1240.
machine, *Gramme* . . . . * "*Engineer*," xlvi. 329.
testing machine, *Herring* . * "*Van Nostrand's Mag.*," xx. 405.
motor, *Ludwig* . . . . . * "*Sc. American*," xlii. 1.
engine, *Pixii* . . . . . * "*Engineer*," xliv. 383.
engine, *Sawyer* . . . . . * "*Sc. Am. Sup.*," 301.
machine, *Varley* . . . . . * "*Sc. Am. Sup.*," 1892.
Werdermann . . . . . * "*Teleg. Jour.*," vi. 22.

E-lec'tro-mag-net'ic Brake. A railway brake operated through electric devices.

Achard . . . . . * "*Scientific American*," xliii. 18.
N. Railway of France . * "*Engineer*," xlv. 456.
Spottiswood . . . . * "*Sc. Am. Sup.*," 807.
"*Manuf. and Builder*," xi. 228

E-lec'tro-mag-net'ic Mal'let. An instrument for plugging teeth. The plunger is reciprocated by a small electro-magnetic engine. See PLUGGER, p. 1750, * "*Mech. Dict.*"

E-lec'tro-mag-net'ic Tel'e-graph. The history of the magnetic telegraph, and the intimate connection of Prof. Joseph Henry therewith, with an account of the origin and development of Prof. Morse's invention, are so well told in a "Historical Account" of the same by William B. Taylor, of Washington, D. C., that it relieves the author from adding to that which he has said on the same subject in "*Mech. Dict.*," pp. 787-789. The "Historical Account" is published in the "*Smithsonian Report for* 1878," and as a brochure. See "*Biographical Memoir of Joseph Henry*," p. 158, *et seq.*

The "*Handbook of Electrical Diagrams and Connections*," by Davis & Rae, New York, 1876, gives an excellent description and series of cuts, showing the instruments, connections, and arrangements of various kinds and systems.

Telegraphy, *Thomasi*, Fr., "*Scientific American*," xxxvii. 40.
German historical collection of Instruments. Description and history, "*Lines' Report, Vienna Exposition*," 1873.
See list under ELECTRICITY for various systems and instruments.

E-lec'tro-mas'sage. See ELECTRO-MASSEUR.

E-lec'tro-mas'seur. An instrument for application of electricity to the human body.

A small hollow metallic roller filled with hot water, and connected with a *Gaiffe* battery; it is rolled over the surface of the body. *Electro-massage.*

Fig. 952.

Post's Electro-masseur.

It is also made in other forms.

E-lec'tro-med'i-cal Ap'pa-ra'tus. See CAUTERY INSTRUMENT, ELECTRIC BULLET SEEKER; BATTERY; GALVANIC BATTERY; and list under ELECTRICITY.

See also list under SURGICAL INSTRUMENTS, pages 2459-2461 "*Mech. Dict.*," *et infra.*

E'lec-trom'e-ter. An instrument for measuring the force of an electric current, p. 789, "*Mech. Dict.*"

See also ELECTRO-DYNAMOMETER, *supra.*

* "*Engineering*," xxiii. 179, 201, 259, 319.
* "*Manufacturer & Builder*," xi. 253.
Hopkins . . . . . * "*Sc. American*," xli. 99; xxxix. 185.
Absolute, Physical Society, London . "*Scientific American Sup.*," 1690.
Capillary . . . . . * "*Scientific American Sup.*," 1319.
Reflection, *Mascart* . * "*Scientific American Sup.*," 4103.
Reversing key, *Lodge* * "*Telegraphic Journal*," vii. 208.

E-lec'tro-mo'to-graph. (*Electricity.*) An invention of Edison by which to obtain mechanical effects with an exceedingly small electric force, and upon long circuits, without the intervention of any electric organ.

It is based upon the principle, that if a sheet of slightly roughened paper, dipped in certain solutions, be laid upon a platinized metallic plate, and there be passed over it a strip of sheet metal (lead, thallium, or platinum), on the passage of a current a certain slipperiness of the surface is produced, which makes the friction much less. A metallic bar, held by a spring, is dragged onward by the friction of the traveling paper, but springs back each time a current passes.

"*Telegraphic Journal*" . . . . . * vi. 382.
"*Scientific American*" . . . . . * xxxix. 17.
"*Lines' Report, Vienna Exposition*," 1873.
See also ELECTRO-CHEMICAL TELEPHONE.

E-lec'tro Mo'tor. See DYNAMO-ELECTRIC MACHINE; MAGNETO-ELECTRIC MACHINE.

E-lec'tro-phone. A telephonic instrument devised by M. Louis Maiché, consisting of an ordinary Bell receiver and a special transmitter. The latter has a glass imbedded in wadding, and placed with its concavity opposite to the mouth tube of the transmitter. Upon the upper edge of the dish rests a ball of carbon, and upon the latter a second ball. When the sound waves set the glass dish in vibration the carbons will be sensible of varying degrees of pressure, and their conductivity will be thereby varied. The corresponding variations of resistance to the current, and consequent variations of potential in the circuit, are revealed as soon at the receiver. — "*Electrician.*"

Maiché . . . . . * "*Scientific Am. Sup.*," 4098.
Pfeiffer, de Courbettes * "*Scientific American*," xlii. 151.

E-lec'tro-phys'i-cal Reg'is-ter. The subject of registering phenomena of life is considered in *du Moncel's* "*Exposé des applications de l'Electricité*," * iv. 439. The memoirs on this subject, by Helmholtz, are referred to, and the apparatus of *Boeck*, called by him the Kymographion.

See CARDIAGRAPH. SPHYGMOGRAPH.
MYOGRAPH. PNEUMOGRAPH.
PLETHYSMOGRAPH. CHEILOANGIOSCOPE.
and references *passim*.

E-lec'tro Pla'ting. On porcelain: In France the object is painted with a mixture to form a basis for the electro deposit. This is made by dissolving sulphur in oil of lavender to a syrupy consistence and mixing it under a gentle heat with chloride of gold or chloride of platinum dissolved in sulphuric ether. This is evaporated to the consistence of paint and applied with a brush to the parts of the china on which the plating is desired. The objects are baked to a biscuit before being plunged in the bath.

Cf.: —	"*Scientific American Sup.*," 626.
Prof. Wright	"*Scientific Amer.*," xxxvii. 177.
Leaves, etc. . . .	"*Scientific American*," xxxv. 47.
Machinery	* "*Scientific Amer.*," xxxvii. 127.
Machinery and plant . .	* "*Iron Age*," xix., Jan. 25, p. 1.
Originator of	"*Scientific Amer.*," xxxv. 312.
Aluminium, etc. . . .	"*Iron Age*," xix., Jan. 25, p. 27.
Bertrand	"*Van Nostr. Mag.*," xvii. 285.
Iron	"*Manuf. and Builder*," ix. 143.

For *aluminium*. Bath of double chloride of aluminium and ammonium; use a strong battery.

For *magnesium*. Bath of a double chloride of magnesium and ammonium in aqueous solution gives strongly adherent layer of magnesium on copper.

For *cadmium*. Use the bromide to which a little sulphuric acid has been added. An acidulated sulphate gives good results.

For *bismuth*. Deposited upon copper or brass from a solution of the double chloride of bismuth and ammonium by the current from a Bunsen element.

For *antimony*. Use double chloride of antimony and ammonium.

For *palladium*. Use double chloride of palladium and ammonium, with or without the battery

"*Comptes Rendus*" . . . . . xxxiv. 227.

Gilding. Prepare bath of

Potassium cyanide	14 to 16 ozs.
Water	1 gal.
Gold oxide	½ oz.

The gold oxide is made by digesting in a capsule over a water bath, —

Gold	1
Aqua regia	20

The *aqua regia* consists of —

Nitric acid	1
Hydrochl. acid	3

When the gold has dissolved, the solution is digested with calc. magnesia and the precipitated gold oxide washed.

Articles of copper, brass, or german silver are boiled for a few minutes in a solution of caustic potash, washed in clear water, plunged for a few minutes in an acid dip: —

Nitric acid	6 1-5 pounds.
Water	1 gallon.

"*Scientific American Sup.*" . . . . . 2540.

E-lec'tro-scope. The electroscope of M. Rameaux consists of two fine fibres of white silk, each fixed at one end by means of a little wax to any support, and free to oscillate in any direction under their point of attachment, and the respective fibres so separated that they cannot foul each other during their swing, or influence each other reciprocally. One of the threads is charged by means of a glass rod with positive electricity. The other is charged by means of a stick of resin with negative electricity. Every body which attracts one of the threads so charged and repels the other is necessarily electrified. Its electricity is of the same sign as that of the thread which it repels. The sensibility of these electroscopes is greater within certain limits as the threads are made finer, longer, and less conducting.

"*Telegraphic Journal*" . . . . . vi. 73.
"*Scientific American Sup*" . . . . . xxxviii. 183.

E-lec'tro-sem'a-phore. (*Railway.*) A semaphore worked by electricity to give signal to approaching trains.

In the block system of railway management, for instance, the road is divided into sections and electric semaphores placed at their termini.

They are also used in the interlocking system which has attained such a great development in the railway termini of the large capitals.

The electro-semaphore is described and represented in "*Railroad Gazette*," * xxiii. 93

E-lec'tro-si-lic'ic Light. A modification of the electric light arrangement in which one electrode is applied to a glass tube, or wall of a glass vessel containing a saline solution. A white vapor is given off, having a slight alkaline reaction. The glass is strongly attacked and devitrified. The spectrum indicates the silicic character of the light although the intense brightness renders it difficult to perceive the lines. Contact with pure silicon in the shape of crystal of hyaline quartz affords the same character of light. — *Planté*.

E-lec'tro-ther'mo-pile. (*Electricity.*) A battery in which a current is produced by the subjection of an element or group of elements to heat. See THERMO-ELECTRIC BATTERY.

E-lec'tro-typ'ing. A substitute for stereotyping. See page 791, "*Mech. Dict.*"

The bath for depositing an iron surface on electrotype plates consists of a concentrated solution of sulphate of iron and ammonium; the battery of four Meidinger cells. The anode is an iron plate with a surface eight times that of the cathode; the latter is of copper. On leaving the bath the iron is brittle and hard, but when heated to a cherry red it becomes malleable and soft. — *Klein*.

Or: Take 100 parts of ferrous-ammonia sulphate, together with 50 parts of sal-ammoniac; dissolve in 500 parts of pure water, a few drops of sulphuric acid being added to acidulate the solution. The copper plate is connected to the negative pole of a battery of 2 or 3 Bunsen elements, an iron plate of equal size being employed as an anode. The solution is maintained at 60° to 80°. The deposit of iron is of a hard, steel-like quality. — *Bottger*.

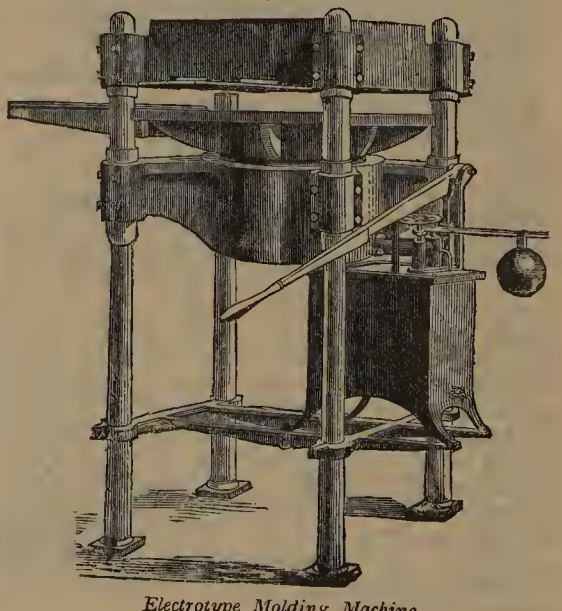
Statue, 12′ high	"*Sc. Amer.*," xxxviii. 338.
Plates from drawings, *Brown*, Br.	"*Sc. Amer. Sup.*," 2242.
Iron electro	"*Sc. Amer. Sup.*," 1457.
	"*Sc. Amer.*," xlii. 184.

Article "*Galvanoplastique*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877.

E-lec'tro-type Mold'ing Ma-chine'. A hydraulic press for taking a wax impression of a form.

The platen has a projecting table upon which the form and mold are placed before being placed in the press. The pump is supported by a frame-work on the cistern below the cylinder, and has a safety-valve graduated to give any required pressure.

Fig. 953.



Electrotype Molding Machine.

The molding case having been warmed is placed on a level table, and the melted wax poured in to make a level surface. It is then black-leaded with a soft brush; the form is put on the platen, and the molding case in reversed position on the head of the press, immediately over, but not touching the form. The bed is then raised to give the proper impression.

El'e-ments. (*Electricity.*) In a galvanic battery, the metals or carbon acted upon by the exciting fluid. See various materials in list of batteries in GALVANIC BATTERY.

El'e-va'ted Rail'way. An urban railway above the line of street travel. See Figs. 1856–1858, pp. 792, 793, "*Mech. Dict.*"

New York . . * "*Engineering*," xxix. 10, 50, 210, 240.
* "*Railroad Gazette*," xxi. 284; xxii. 125.
* "*Scientific American*," xxxiv. 25; xxxviii. 18, 62, 66, 175, 178, 367, 370; xli. 255, 310, 338.
Early examples "*Scientific American*," xliii. 281.
New York . . * "*Scientific American Sup.*," 1933.

El'e-va'tor. 1. The elevator belt with cups is the invention of Oliver Evans, of Philadelphia, 1780.

2. The elevator, as a building for the shipment, transhipment, and storage of grain, is described on pp. * 794, 795, "*Mech. Dict.*" See also the following references: —

Engine, *Cooke & Beggs* * "*Manufacturer & Builder*," xi. 9.
Stokes & Parrish . . * "*Iron Age*," xxi., May 2, p. 18.
Davis . . . . . * "*Iron Age*," xxi., May 2, p. 41.
Freight, endless chain.
Bates . . . . . * "*Builder & Woodworker*," xvi. 239.
Grain, Canton, Md. . } * "*Engineering*," xxii. 485, 539, 523,
N. Y. Central R. R. } 519.
St. Louis, Mo. . . . * "*Scientific American*," xxxvi. 390.
Erie, Pa. . . . . * "*Scientific American Sup.*," 1256.
* "*Scientific American Sup.*," 737.
Hoist, *Mason & Co.* . . * "*Iron Age*," xviii., July 20, p. 1.
* "*Iron Age*," xxi., May 16, p. 39.
Hydraulic, *Burdon* . . * "*Manuf. & Builder*," ix. 121, 146.
Howard Iron Works . * "*Iron Age*," xx., Nov. 1, p. 1.
Lane & Bodley . . . * "*Iron Age*," xix., May 24, p. 1.
Stokes & Parrish . . * "*Iron Age*," xx., Sept. 20, p. 1.
Passenger.
Cooke & Beggs . . . * "*Iron Age*," xxi., Jan. 3, p. 1.
Potter . . . . . * "*Scientific American Sup.*," 156.
Evans . . . . . * "*Scientific American*," xliii. 24.
Trocadéro, Paris . . * "*Scientific American Sup.*," 2236.
Steam, *Bacon* . . . . * "*Manufact. & Builder*," viii. 217.
Transfer of grain by . * "*Scientific American*," xli. 207.
Water Power, *Hale* . . * "*Manufact. & Builder*," viii. 49.

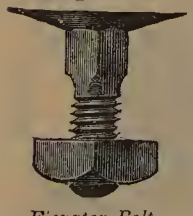
3. (*Surgical.*) *a.* An instrument for lifting an excised or depressed portion of the cranium in trepanning.

b. An instrument for replacing the uterus.

c. A forceps or screw for lifting a tooth or root.

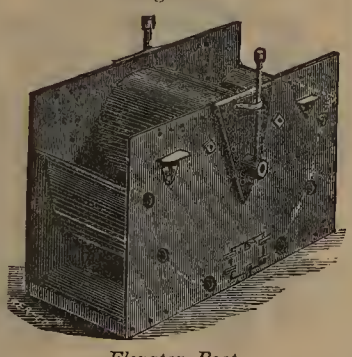
El'e-va'tor Bolt. An iron bolt with a peculiar flat head which is countersunk by pressure into the working face of the belt, while the threaded end and the nut secure the bucket to the belt. Fig. 954.

Fig. 954.



Elevator Bolt.

Fig. 955.



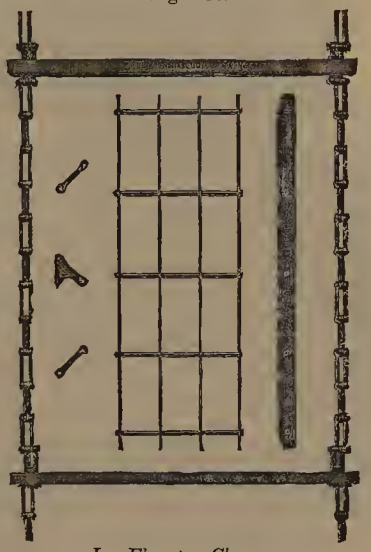
Elevator Boot.

El'e-va'tor Boot. The lower end of an elevator leg. Fig. 955. See Fig. 1863, p. 795, "*Mech. Dict.*" It is of iron and holds the lower roller, around which the elevator belt runs.

Hawkins . . . . . * "*American Miller*," vii. 8.

El'e-va'tor Chain. A chain used with ice elevators. It is flat, runs over pulleys above and below, and has jogs or bars upon it which form rests for the ice as the chain mounts the incline. Figs. 956 and 957 show several forms and detached parts. See also ICE ELEVATOR.

Fig. 956.



Ice Elevator Chains.

El'e-va'tor En'gine. One used in connection with a passenger cage, or platform for hoisting merchandise.

Fig 957.

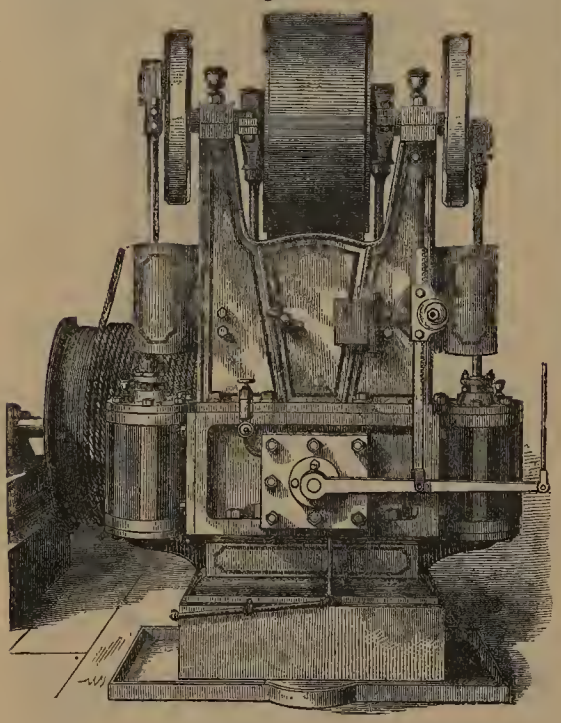
Ice Elevator and Carrier Chains.

The "Metropolitan" elevator, shown in Figs. 958 and 959 comprises (1) a double cylinder and reversible steam engine; (2) a winding drum immediately connected with the engine; (3) a safety drum placed over the hatchway; (4) guide-posts extending from cellar to roof, faced with safety-locks, ratchets, and between which (5) the safety platform is raised and lowered by a wire lifting-rope, suspending it from the safety drum, while another wire rope connects the safety drum at the top of the hatchway with the drum at the foot of the hatchway and immediately connected with the engine.

The speed of the platform is optional, from 60′ to 200′ per minute, and wherever it is stopped it is immovably held by a strong brake, combined with the engine and winding drum. The brake is so arranged as to be brought into and released from action simultaneously with the stopping and starting of the engine, but causing no friction, while the engine is running. The platform is fitted with safety-locking pawls, combined with a steel spring, and mechanism for forcing the pawls into contact with the safety-lock ratchets on the vertical guide-posts in case the rope should break. The greatest possible distance the cage should fall is 3″, the pitch of the ratchets. The safety-drum is the medium through which the motion of the engine is communicated to the platform. Its duty is to limit the rate of motion of the platform, and to stop it if any portion of the engine-gear should break. A governor, *P*, and tripping-gear, *K I H*, will in the latter case bring the break *F* into action and stop

the platform. An automatie stop-motion limits the distance the platform ean traverse to the spaee hetween the upper

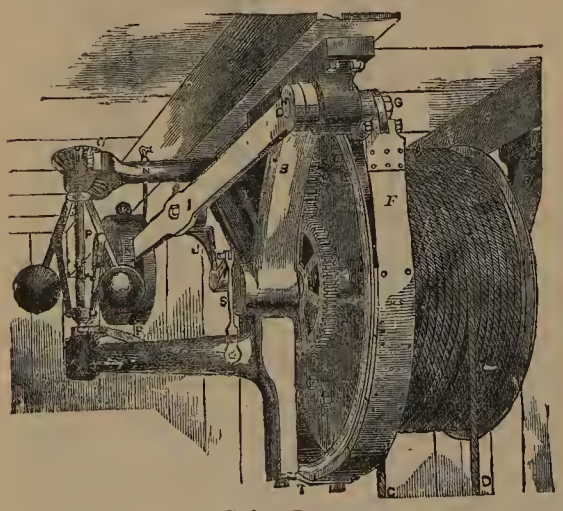
Fig. 958.



Elevator Engine.

and lower landings, automatieally shutting off steam at those points.

Fig. 959.



Safety Drum.

El'e-va'tor Scales. Large scales weighing 100 bushels of wheat at a time, and placed in the upper story of an elevator to weigh incoming grain before discharging into the storage bins. See GRAIN WEIGHING MACHINE, *infra.*

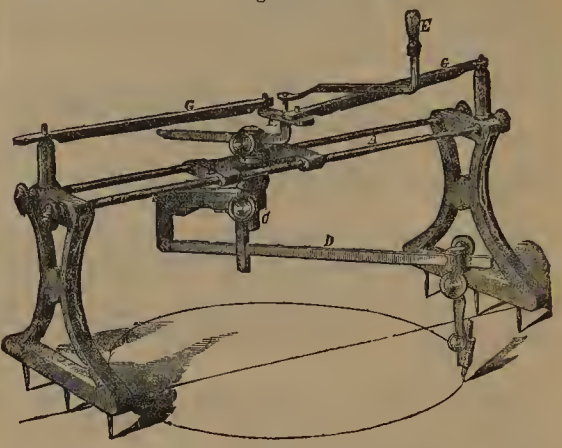
Ell. An L-shaped pipe coupling, at a bend of the circulation. An *elbow.* See BEND. The *ell is* plain, hubbed, or flanged.

El-ler-hau'sen Steel. (*Metallurgy.*) Steel made by adding iron ore (magnetic) to the bath of pig-iron, to reduce the earbon, relatively.

El-lip'so-graph. An instrument for describing ellipses. Toulmin's ellipsograph is a frame placed upon the paper on the drawing-board in a certain relation to the axes of the ellipse to be drawn.

A description of the mode of using will explain the construction: Place the center points upon a line drawn through the minor axis and equidistant from the center of the ellipse. Set the pen point at the extremity of the major axis, and elamp it hy means of the hinding screw on the arm, then turn the arm 90° to the minor axis and set the pen to its extremity by loosening the hinding screw between the parallel rods and sliding the carriage back until the pen point comes to the required point, then elamp it firmly, turn the erank, and the ellipse is drawn perfeetly. For small el-

Fig. 960.



Ellipsograph.

lipses, see that the pen point is set perfectly square with the arm *D*. When the pen is set imuediately under the arm *F*, the pen will draw a straight line. When the arm *F* is outside the pen point, the motion of the pen is reversed. First start the pen on a slip of paper laid on top of the paper, then when it runs off the slip on to the paper, stretehed and prepared for drawing, it will draw a figure eomplete, and the lines will joiu.

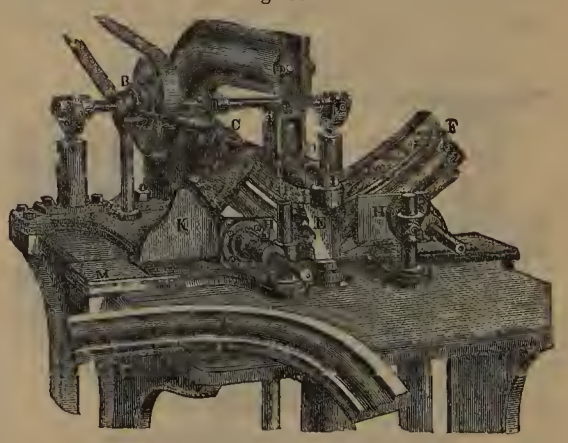
Toulmin . . . . "*Scientific American Sup.*," 689.
Balch . . . . . * "*Scientific American*," xl. 324

The latter is an attaehment to ordinary compasses, and has a double leg, which is used in rotation around the angle of a reetangular triangle laid on the paper.

El-lip'ti-cal Mold'ing Ma-chine'. An attaehment to a molding for sticking elliptical or circular moldings on any radius, or, when molding ellipses, to work on a changing radius; as in finishing arches, window and door heads, and arehitraves.

The Boult elliptieal molding attaehment is shown in Fig. 961, and is used in eonneetion with an upright spindle. The

Fig. 961.



Elliptical Molding Machine.

parts of the attaehment are ereeted upon an independent hed-plate. The work is attached to a pattern of the desired shape which has adjustable pressure plates for holding the work to the proper position. It has an automatic worm-feed, eontrolled hy a frietion elutch matching into a loose pulley.

A is the pulley that drives the feed-works, and reeeives its motion by belt from a pulley on the eounter-shaft that drives

the main spindle. *B* is a friction clutch that connects the pulley with *A*, and drives the screw-shaft. *C* is a screw pinion that meshes into a worm on shaft above, by which means the feed roller *D* is driven. *E* shows the upright cutter head. *F* is the form or pattern used with the work attached: *H H* are adjustable pressure plates or guides for holding the work in place. *K* is an adjustable gage or fence governing the thickness of the work. *G* is a piece of the work finished.

The machine will run in either direction for feeding the stuff and working the molding, and will work moldings of any width from 1″ to 5″, and up to 1.75″ in thickness.

E-mail′ Ink. Made by Louis Müller, Leipzig.

Colored inks — black, white, red, blue — used with a quill on glass, porcelain, ivory, marble, bone, mother of pearl, or metal. Cannot be removed by any liquid.

E-maille′. (*Fine Art Metal Working.*) The process of inlaying metal with metal; an oriental process of great labor and patience, consisting of engraving, inlaying the metal which is secured by undercutting, and burnishing. Modern science has much simplified the methods.

The object to be inlaid is entirely covered with varnish, portions of which are removed by a graver so as to form the design; and thus prepared, it is subjected to the action of a galvanic bath of gold or silver, which deposits the metal in the places laid bare by the graver.

Or: after the removal of the varnish, according to the pattern made by the graver, the object is plunged into a solution of cyanide of silver. The salt is deposited on the lines from which the varnish has been removed; the object is heated in a muffle furnace, and the metal appears on the black patina. Inlaid patterns of gold and silver may be obtained, either of their natural brightness or with a dead surface, the latter being effected by different processes of oxidation; so that, on the same object, by making use of the protecting varnish, designs in gold and silver of various degrees of luster may be combined. — *Morin.*

Em-balm′ing Pump. Tiemann's embalming pump, shown in Fig. 962, is made of brass nickel-plated, and with metallic valves.

Fig 962.

Embalming Pump.

Gaurel injected the veins with sulphate of alumina. Falconi injected into the body sulphate of zinc. Chloride of zinc and sulphate of soda are also sometimes used.

For temporary preservation of bodies for anatomical investigations the following requisites are necessary. The body should remain in a soft and flexible condition for a period of at least three months, the tissues should not change color, the *material* should not be injurious to the health of the operator, nor spoil the instruments used in the operation, and it must be either free from or have an agreeable odor, and be cheap.

Dr. Wywodzoff, of St. Petersburg, Russia, recommends thymol diluted with water and glycerine:

R	Thymolis . . .	sc. ij.
	Glycerine . . .	lbs. iv.
	Aq.	lbs. ij.

The Brunelli process: —

1. Cleanse the circulatory system with cold water till the latter issues clear. Time required, 2 to 5 hours.

2. Inject alcohol to absorb water. 15 minutes.

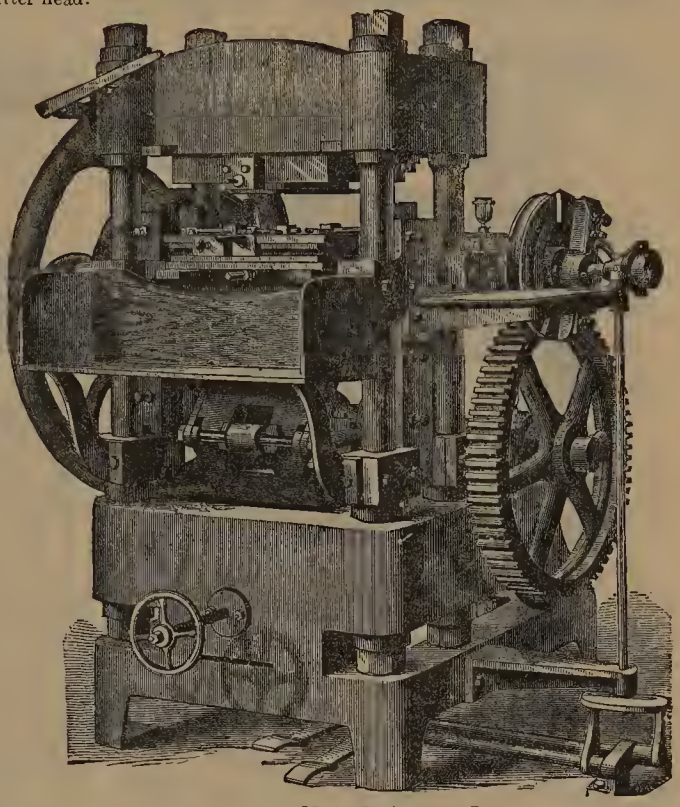
3 Ether to abstract fat. 2 to 10 hours.

4. Solution of tannin to form insoluble compound with the tissues. 2 to 10 hours.

5. Dry the body in a current of air previously passed over heated chloride of calcium. 2 to 5 hours.

The Tranchina method: Eight decigrams of arsenious acid, combined with a little cinnabar, are dissolved in 9 kilograms of spirits of wine, and injected, *secundum artem*, into the carotid artery. For more than two months the body remains fresh, inodorous, inflexible, and (thanks to the cinnabar) of its natural color. Thereafter desiccation commences, and it indurates so as to last for any time. Modifications by Gannal and others have improved upon Tranchina's method. — "*Lancet.*"

Fig. 963.



Hoe's Embossing Press.

Ancient Egypt . . . . . "*Sc. Am.*," xxxvii 117.
Embalming injector, *Richardson* * "*Sc. Am. Sup.*," 813, 2472.
See also History and Recipes: page 797, "*Mech. Dict.*"

Em-bank′ment. See —

Thames . . . . . "*Van Nostrand's Mag.*," xviii. 569.
French railways, *Laboulaye*, "*Dictionnaire des Arts, etc.*," "*Chemins de fer*," i., Fig. 31.

Em-blem′a-ta. (*Fine Art Metallurgy.*) Ornamental figures in relief, which are large and detachable from the object.

Em-boss′ing Ma-chine′. (*Add.*) 3. Embossing machine for stuffs, Fig. 1869, p. 798, "*Mech. Dict.*" See also *Laboulaye's* "*Dictionnaire des Arts, etc.*," article, "*Impressions sur étoffes*," tome ii., Figs. 61, 62.

Steinlein's machine for embossing fabrics, * "*Scientific American Supplement*," p. 229.

Em-boss′ing Press. 1. (*Bookbinding.*) A press used in embossing or gilding on card-board, leather, book covers, etc.

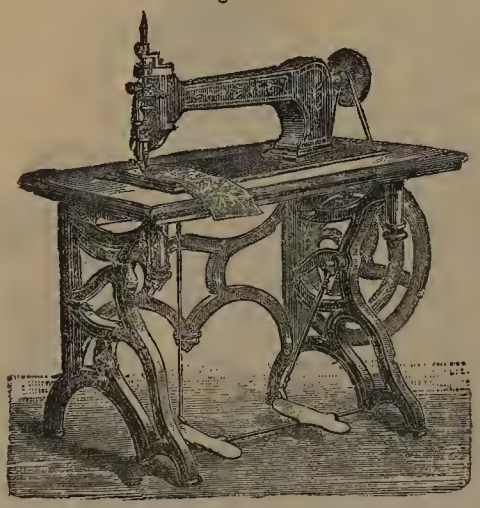
The bed is guided by the frame, so that it does not tilt in giving pressure at the corners. The feed guides or bed are adjustable in either direction. The toggle is driven by a crank within and by means of a friction clutch; the bed can be started or stopped without reverse or jar. The bed is constantly in motion and it has sufficient travel in order to allow the operator time to take off and place the work. An ink fountain and inking attachment are affixed when necessary.

2. A press which takes the place of a drop-press in embossing the handles of silver spoons, forks, ladles, etc., and for stamping medals. The press will give a pressure of 1,000 tons and receive dies 2″ × 12″ or 4″ round dies. The upright steel columns that take the principal strain are 5″ diameter and the large nuts have worm gear on their

sides, operated by hand wheel, giving very delicate adjustment.

Em-broid'er-ing Ma-chine'. The Bonnaz

Fig 964



Embroidering, Overseaming, and Braiding Machine.

machine is adapted to embroider cloth with a chain-stitch, and to stitch braid or chenille upon the cloth in fancy patterns.

A hooked needle is supplied with thread at each descent below the material by a rotary reciprocating thread-carrier, and the thread is drawn above the cloth. The loop so formed is held above and upon the surface of the material until the needle descends within and draws a new loop up through it The fabric-feeding foot is universal as to the direction of its movement, and consequently moves the fabric in any desired direction from the needle, thereby permitting the stitching to follow any pattern or design printed or stamped on the fabric. A crank-handle controlled by the operator changes the direction of the feed according to the design upon the fabric to be embroidered

Rose . . . . * "*Manufacturer and Builder*," ix. 118
Heilmann . . * *Laboulaye's* "*Dictionnaire des Arts, etc*," tome i., article, "*Broiderie*"

Em-bry-ot'o-my In'stru-ments. (*Surgical.*) Instruments for cutting a fœtus into pieces within the womb in cases of obstructed labor. Including those instruments which are fatal to the fetus, though they do not sever the parts, the following is an approximate list: —

Perforators	Craniotomy forceps.
Forceps of various kinds.	Cephalotrite.
Blunt hook.	Placenta forceps.
Crochet	Vectis.
Decapitating hook.	Saw forceps.

Representatives of each of which are placed under their alphabetical heads, and more *in extenso* in *Tiemann's* "*Armamentarium Chirurgicum*," pp 103-114, Part III

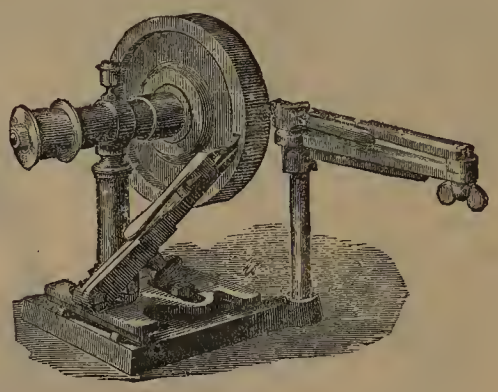
Em'e-ry Board. Card-board pulp mixed with 30 to 50 per cent. emery of the required grade and poured into cakes.

"*Manufacturer and Builder*" . . . . ix. 269.

Em'e-ry Grind'ing Ma-chine'. Fig. 968 is a machine for sharpening chisel-bits. It has a traversing way for grinding on the flat, and a swinging rest for the face of the wheel, together with adjustable nippers. See list following: —

Band . . . . . * "*Scientific American*," xl. 278.
Band polisher, *Slack* . * "*Engineer*," xlvii. 187.
Board . . . . . "*Manufact & Builder*," ix. 269.
Grinder.
Berthon & Bell, Br. . * "*Engineer*," xlvi. 248.
Dexter . . . . . * "*Iron Age*," xviii., Nov. 30, p. 1.
Tanite Co. . . . . * "*Manuf. & Builder*," viii. 25, 36.
Thomson & Sterne . * "*Eng'ing*," xxiv. 500; xxv. 447.
* "*Scientific American Sup.*," 1854.
Union Stone Co. . . * "*Scientific Am.*," xxxiv. 70, 210
Paris, 1878 . . . * "*Scientific American*," xxxix. 67.

Fig. 965.



Bit-grinding Machine.

Lap machine, *Thomson, Sterne, & Co.*, Br. . * "*Engineer*," xlix. 386.
Vulcanite wheel . . . * "*Eng. & Min Jour.*," xxiii 86.
Wheel cushioned.
Harding . . . . . * "*Scientific American*," xxxiv 86.
Butler, Br. . . . . * "*Engineering*," xxi. 26.
Lehigh . . . . . * "*Scientific Amer*," xxxviii 255.
Ransome, Br. . . . * "*Engineer*," xliv. 4.
Manufactory.
Tanite Co. . . . . * "*Scientific American*," xlii. 111.
Wheels, paper on, by *Bateman*, Br. . . . * "*Scientific American Sup.*," 1089
Wheel stand
Shoener & Allen . . * "*Scientific American*," xl. 294
Wheel-balancing . . "*Scientific American*," xxxvii. 65.
Bateman . . . . . "*Van Nost's Mag*," xviii. 502.
Wheels, celluloid . . "*Manufact. & Builder*," ix. 125.
Wheels, on . . . . . "*Iron Age*," xx., Dec. 13, p. 68.

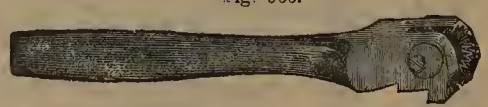
Report of J. M. Safford, "*Centennial Exhibition Reports*," 1876, Group I., vol. iii., p 189.

Em'e-ry Pla'ner. A machine tool with a traversing bed, and an emery wheel which takes the place of the cutter or chisel of an ordinary planer. — *Newman.*

Em'e-ry Stone. A mixture of gum-shellac and emery. Soluble glass is substituted for the shellac in Germany, with apparent advantage. — "*Revue Industrielle.*"

Em'e-ry Wheel Dres'ser. A tool to replace diamond tools in dressing emery wheels to shape.

Fig. 966.



Huntington's Emery Wheel Dresser.

The head of the tool has independent loosely-jointed sharp-toothed cutters on a steel mandrel. The hooks on the under side of the tool are for catching upon the rest when applying the tool to the rotating corundum wheel.

The Union Stone Co.'s emery dresser is a diamond mounted in a stock.

E-nam'el. (*Fine Art Metal Working.*) Enameling on metal is of several kinds: —

1 Simple overlaying of vitreous colors which are fused in a muffle.

2. Translucent enamel colors laid over a design which has been etched on (engraved), or hammered out (*repoussé*), of the metal.

3 *Cloisonné* Pattern raised on the surface by means of wire or strips of metal welded on to it, and enamel spread in the spaces between the metal.

4. *Champ-levé.* Lines and surfaces cut out of the metal and filled with enamel. Allied to *niello*.

5. Enamel is coarsely laid on, then outlined with strips of copper or gold. A Japanese imitation of true *cloisonné*.

6. A thick coat of enamel is melted on and covered while still hot with a network or shapes of thin gold which imbed in the enamel. Finished with the graver. A Bengalese art.

E-nam'el-ing.

Enameling was practiced by the Egyptians, Persians, Etruscans, and Greeks. The practice was to cut out the figure to receive the enamel which was burnt in. It was practiced in Italy as far back as the time of Porsenna, and, later, Faenza and Castle Durante were famous for it. James Toutin, of Chasteauduu, in 1630, invented the opaque enamel: Mortière used it iu rings and watch cases; Chartier in flowers; Petitot and Bordier in portraits; Louis Guernier in excellent miniatures.

See article "*Emaillage*," tome iv., ed. 1877, *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," on iron, porcelain. For composition, *Ibid.*, tome ii., article "*Email.*"

(*Ceramics.*) The enameled steatite figures of the Egyptian pantheon are among the earliest examples of the use of enamel. The colors are white, yellow, blue, green, and purple, and the blue especially is of unsurpassed quality. The base is probably stanniferous.

Bricks found in the ruins of the Mesopotamian cities are also found with stanniferous glaze.

At Warka have been found great numbers of earthenware coffins, many glazed and some decorated.

The Saracens during their occupancy of Spain made great advance and the Hispano-moresque vases and dishes, as well as the tiles known as *Azulejos*, testify to the taste and skill of this remarkable people. The colors were brilliant; red, blue, green, yellow, and white, and the decorations in the style familiarly known as arabesque.

The convent of St. Paul, at Leipsic, is perhaps the earliest surviving instance in Christian Europe of the use of enameled tiles. The monument of Henry IV., of Silesia (d. 1290), in the Kreuzkirche of Breslau, is a fine instance of glazed pottery with a life-sized figure of the deceased.

The stanniferous enamel of the Saracens was rediscovered by Luca della Robbia, of Florence, in the 15th century, and largely superseded the lead glaze. Luca della Robbia ornamented with bassi-rilievi the Campanile of the Duomo, of Florence. The process was again rediscovered by Bernard Palissy in the middle of the 16th century.

At the Vienna Exhibition in 1873 specimens were shown of the beautiful tea set presented to Lord Dudley on his marriage. The decoration consists of turquoise blue enamel put on in drops near together, so that the surface appears to be thickly set with turquoise. Each cup and saucer is carefully mounted in a stuffed morocco case. The small set of 6 pieces was valued at $6,000.

(*Glass.*) Wares or panes with vitrifiable colors baked on the surface. Glass enamel contains lead, oxide of tin, or arsenious acid, besides metallic colors.

Among other modes of enameling glass, the following is the practice with *etched enamel:* —

The enamel in paste is laid with a brush upon the glass, dried, etched in patterns or designs by tools, and the glass fired to vitrify the enamel and cause it to adhere to the glass surface.

Flocked enamel is when the surface of the glass has previously been deglazed, giving it a dull semi-opaque surface.

Among the most celebrated specimens of glass enamel are the sapphire nuptial goblet, the work of a Muranese artist of the 15th century and now in the museum of Venice: and the Tazza, of St. Mark's Treasury, Venice, blown in black glass, enameled in various colors and gold, with medallions and Coptic inscriptions divided in zones. The tazza is of the 11th or 12th century, and, though not over 6″ high, is valued at 80,000 francs. It was taken from Venice to France by Napoleon, but afterwards restored.

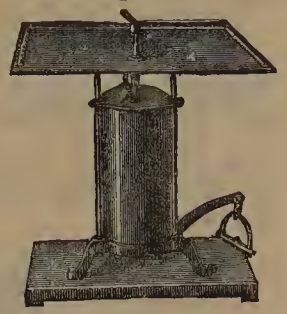
(*Cast Iron.*) Silesian process: After pickling and cleaning the vessels, they are covered with a ground made as follows: Quartz, 50; fluorspar, 7.5, and borax 22.5 parts fused together. Of this, 16 parts, 6.5 to 12.5 of quartz, 4 to 6.5 of clay, and .5 of borax, are ground in a wet mill, with an addition of 2.5 clay and .66 borax. This is laid on and burned, forming a yellowish-brown mass. For the outer coating 2.5 powdered fluorspar, 1 zinc-white, 4.75 tin oxide, .75 bone-ash, and .03 to .5 smalt are well mixed. Of this 9 kilograms are mixed with 16 of finely-ground fluorspar, 9.5 borax, 3 25 soda, and 1.25 to 1.5 niter, and the whole fused together. The product is powdered, and 30 kilograms of it are wet ground with six cups of about 140 c. c. of white clay, and .3 of zinc oxide. This is laid on and burned, completing the work. *Birsch* in "*Dingler's Journal.*"

See also ENAMEL, p. 800, ENAMELED WARE, p. 801, "*Mech. Dict.*" See also GRANITE WARE, *infra.*

	"*Manufacturer & Builder,*" ix. 269.
	"*Manufacturer & Builder,*" ix. 245.
Cooking vessels . . .	"*Scientific American Sup.,*" 749.
	"*Scientific American,*" xxxvi. 21.
Hardware	"*Iron Age,*" xix., June 7, p. 9; xix., June 28, p. 1.
Hollow-ware	"*Am. Manufacturer,*" July 23, 1880, p. 12.
Leather	*Laboulaye's* "*Dict.,*" article "*Cuirs Vernis.*"

E-nam'el-ing Forge. The enameling forge and table of *Enfer et ses fils*, Paris, is shown in Fig. 967. Beneath the table is the Chinese lantern bellows worked by the foot. The air jet is on top, the lamp or furnace is not shown in position.

Fig. 967.



Enfer's Enameling Forge. French.

En-caus'tic. Wax bleached in sea-water and steeped in natron dye was the basis of the classical encaustic painting. Encaustic tiles were first made in England by Italians settled there.

Article "*Poteries*," Figs. 3700, 3701, *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" iv., ed. 1877.
Article "*Encaustique*," tome ii., *Ibid.*

End'less Belt Grind'er. A grinding or polishing machine having a belt running over pulleys and payed with emery, crocus, putty-powder, or what not, to grind or polish objects held against it.

End'less Bed Pla'ner. A wood-planing machine which has a roller bed, or an endless slat bed traveling on rollers.

Goodell & Waters . * "*Manufacturer & Builder,*" ix. 271.

End'less-chain Horse'-pow-er. One, the inclined track of which passes over pulleys, as in *A B*, Fig. 2568, p. 1125, "*Mech. Dict.*"

En-der'mic In'stru-ments. (*Surgical.*) Instruments for the administration of medicine, etc, through the skin. See HYPODERMIC SYRINGE, Fig. 2630, p. 1160, "*Mech. Dict.*" Also called DERMOPATHIC INSTRUMENTS. See also ACUPUNCTURATOR.

En'do-scope. (*Surgical.*) A speculum; for examination of the urethra, bladder, rectum; specifically applied to the urethral speculum; the latter is also known as a *meatoscope.*

See the following from *Tiemann's* "*Armamentarium Chirurgicum:*" —

Figs. 9, 10, 11 *b*	p. 2, Part III.
Fig. 548	p. 117, Part III.
Fig. 59	p. 17, Supplement.

The instrument has three parts: a glass tube with flaring

Fig. 968.

Dr. Skene's Endoscope.

mouth; a mirror with handle attached; a hard rubber sheath, with a fenestra, by which application can be made to diseased points. Light is thrown into the tube by means of a concave mirror

End Play. The allowance made for end-motion in an axle-shaft, etc. *End-shake* in watch-making.

En'gine. A motor. See STEAM ENGINE, AIR ENGINE, GAS ENGINE, etc.

See references as follows: -

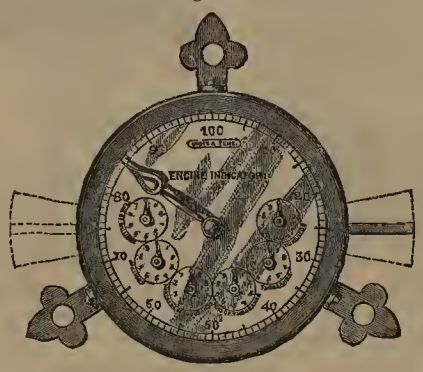
Coupling, *Haswell*, Austria	* "*Engineer,*" l. 279.
Rotter, Austria	* "*Engineer,*" xlvi. 164.

Jack, *Taylor* . . . . . * "*Scientific Amer.*," xxxv. 83.
Lathe, weighted. * "*Engineer*," xlii. 24.
Pratt & Whitney . . . * "*Thurston's Vienna Report*," ii. 227.
Turning lathe, *Tour à guillocher* * in article "*Tours Composés*," *Laboulaye's* "*Dict.*," iv.

See also ROSE ENGINE, p. 1983, "*Mech. Dict.*"; GEOMETRIC LATHE, 963, *Ibid.*

En'gine Coun'ter. A register for keeping account of the revolutions of a shaft, the pulsations of a beam or what not. Usually on the principle of the gas meter; a train of wheels. Illustrations may be found under ARITHMOMETER, pages 143, 144, "*Mech. Dict.*"

Fig. 969.



Engine Counter.

The instrument shown is used for indicating the speed of engines, pumps, machines, shafting, printing presses, brick machines, etc. The dials register up to 100,000,000.

En'gine Cup. An oil cup for an engine shaft or cylinder. See LUBRICATOR, Fig. 3011, p. 1361, "*Mech. Dict.*"

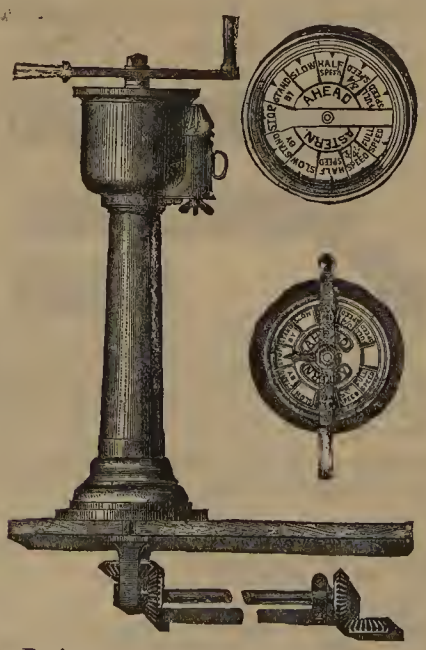
En'gine Reg'u-la'tor. A governor.

Specifically: an invention by Sterberg, of Magdeburg, in which the centrifugal motion of glycerine in a bowl-shaped vessel on a vertical shaft is made to lift a disk, and so operate a stem and governor valve.

"*Scientific American*" . . . . . * xl. 195.

En-gi-neer's' Ham'mer. A hammer with one flat, round face, and a transverse edge peen.

Fig. 970.



Engine-room Telegraph. (*British Navy.*)

En'gine-room and Steer'ing Tel'e-graph. A means of communication between the officer on the bridge and the engine-room or wheel-house.

Fig. 970 shows the engine-room telegraph, which consists of a brass pillar on the bridge, with a communicator dial, index handle, and lamp.

The figure also shows the pillar dial, and engine-room dial, and a portion of the bevel-wheel and shaft arrangement for communication.

The steering telegraph is similar, with the necessary variation in the dials, showing the compass-points.

Eng'lish Knot. (*Nautical.*) A form of knot shown at 39, Fig. 2777, p. 1240, "*Mech. Dict.*"

En-graved' Glass. Glass-cutting and engraving are described on pp. 978, 979, "*Mech. Dict.*" A late process of great beauty is as follows: —

Upon a groundwork of milk-white or opal glass thin coatings of blue and rose-pink glass are spread successively. The pink colors are especially remarkable for their delicate gradations and shades of color. A great variety of small objects for decoration are made in this manner. They are handed over to the engraver, who with his wheel cuts through the outer coats of color down to the groundwork of white glass. Extremely fine lines and delicate effects may be so produced. The process invites and requires careful drawing and skilled designing. At the Paris Exposition, 1878 were exhibited services in Egyptian, Celtic, Indian, Assyrian, Persian, Arabian, Greek, and Byzantine designs.

Among the purely decorative objects were a pair of vases, each about 15″ high, upon which portions of the group upon the frieze of the Parthenon are copied by cutting in miniature, — on one vase in intaglio and on the other in relief. Two years were required for the engraving. They are valued at about $2,000 each. One two-handled vase, about 20″ high, is a most elaborate work, representing Pluto and Proserpine in intaglio on the body of the vase, with Grecian and Pompeian ornamentation on the handles and neck.

En-gra'ver's Glass. A lens placed in a small horn tube, and held by the muscles of the eye orbit. Similar to a watchmaker's glass. Fig. 708, p. 2734, "*Mech. Dict.*"

En-gra'ving Ma-chine'. See p. 804, "*Mech. Dict.*"

And chasing, *Atchison*. * "*Scientific American*," xxxiv. 274.
Electric . . . . . "*Scientific Am. Sup.*," 448, 2434.
Bellet . . . . . "*Telegraphic Journal*," vii. 100.
Machine, *Königslow* . * "*Am. Manufact.*," Jan. 3, 1879.
Photographic, *Scamoni* "*Scientific American*," xxxix. 82.
Process . . . . . "*Scientific American*," xxxv 134.
Cleaning engravings . "*Scientific American*," xxxvii 339.
"*Scientific American Sup.*," 1975.
Transferring to glass . "*Scientific American*," xxxvii. 342.

Barrère, Laboulaye's "*Dictionnaire des Arts et Manufactures*," tome iv., ed. 1877, article "*Epicycloides.*"

See also article "*Gravure*," *Ibid.*, tome ii., Figs. 1107, 1107 *bis.*

Also article "*Tours Composés*," *Ibid.*, tome iv.

Barrère. *Gallet.*
Perkins. *Perreauz.*
Conté. *Collas.*

See also ELECTROGRAPH, *supra.*

En'si-lage Cut'ter. A machine for cutting green corn stalks or other green feed, to be stored in pits (*silos*) for winter feed.

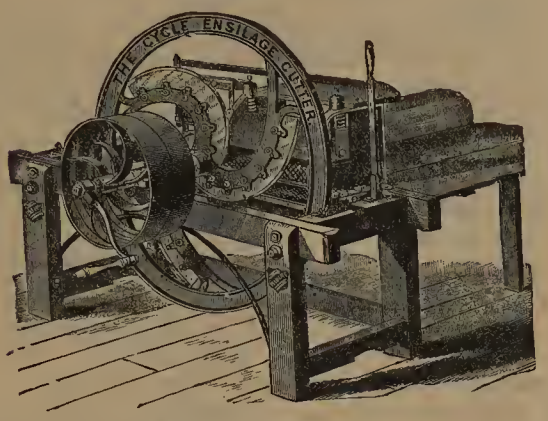
The process of keeping reminds one of *sauer krout*, the material being cut small, pounded, pressed, and placed in a vessel, the sides and bottom of which are air and water-tight. The corn-stalks gathered at the time of silking are cut to a length of say 4-10″, deposited at once in the silos, spread, tramped, covered with boards upon which a heavy weight is placed to condense the ensilage. In winter it is taken out in such a way as to expose but moderate surface to the air, operating in the manner indicated by Fig. 972. The pit becomes charged with carbonic acid, and excludes air when there is no agitation.

The process is the invention of *M. Auguste Goffart*, of Burtin, Sologne, France.

See Dr. Knight's report on agricultural implements at Paris Exposition, in 1878, vol. v., pp. 243–254, cuts of *Goffart's* silos.

The best cutter for the purpose is that of the New York Plow Co., the President of which, Mr. J. B. Brown, has translated M. Goffart's pamphlets and been chiefly instru-

Fig. 971.



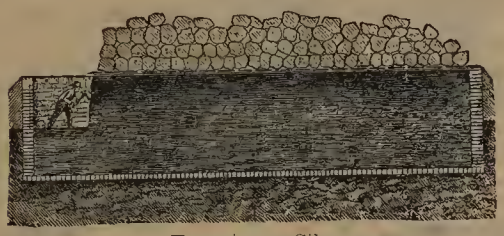
Brown's Ensilage Cutter.

mental in introducing the ensilage of maize to the American farmer.

The cutter shown in Fig. 971 has three curved blades on a wheel, rotating in a plane across the throat of the machine. The knives have a long draw-cut, so arranged that the cut is continuous and steady, a following knife commencing to cut before the previous one concludes its cut. The machines are adjusted to cut $\frac{3}{8}''$ or $\frac{3}{4}''$, or to $\frac{1}{2}''$ and $1''$.

The feed is stopped and started instantly by a lever. The cover over the knife is not shown. The curve of the knife

Fig. 972.



Emptying a Silo.

is such as to slip away any stones. The steel cutting-plate is separated from the face-plate. The rollers are combed. An endless band elevator raises the cut stuff and drops it into the silo. The cutting power is from 2 to 10 tons of green stalks per hour, according to size of machine. The speed of wheel, 300 to 400 revolutions per minute. The power, from 2 to 4-horse.

Ensilage pits, *Potter* . . "*Sc. Am. Sup.*," 3846, 3861, 3926.

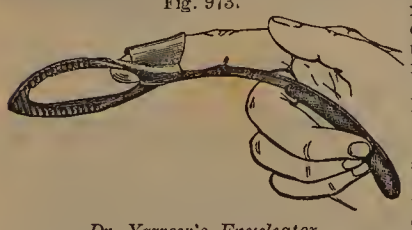
The British Hache-mais, for the French market, is made by Richmond & Chandler, and French machines are also made for the same purpose. See CHAFF CUTTER, page 158, *supra*.

En'to-mo-log'i-cal Pin. A delicate thin pin for impaling objects.

E-nu'cle-a-tor. (*Surgical.*) An instrument, the name of which is derived from the act of uncovering and removing, as a nut from its kernel.

The figures refer to *Tiemann's "Armam. Chirurgicum."*

Fig. 973.



Dr. Yarrow's Enucleator.

1. An instrument with a loop end for removing uterine and ovarian tumors, *Sims'*, Fig. 467, Part III.

2. A sharp comb or claw attachable in manner of a thimble to the end of the finger, to detach and remove a sac or tumor. *Emmett's*, Fig. 102, Part V.

In *Yarrow's*, Fig. 55, Supplement, the thimble carries a loop to place over the object: it is practically a serrated scoop on an extension of the index finger. See Fig. 973.

3. An instrument to grasp and extract the eye-ball in the operation of extirpation, p. 25, Part II.

See ÉCRASEUR for an instrument for a somewhat similar purpose, but of different construction.

En'vel-ope Ma-chine'. The machines of Cohen, Lockwood, and Raynor & Co. were shown in operation at the Centennial Exhibition.

Cohen's uses blanks previously made on cutting press. It folds, gums, and finishes 48 envelopes per minute.

Lockwood's machine works from the web of paper, wasting very little stock and making the square pocket envelope, pasted up each side, and with a gummed flap. It cuts from the roll, folds, gums, and counts 120 per minute, delivering in bunches of 25 each, equal to 72,000 per day. It has worked to 160 per minute.

Raynor & Co.'s machine gums and folds envelope blanks, previously cut upon a press. *Ball's* patent; making 48 per minute.

"*Scientific American*" . . . . . xxxvi. 281.

Ep'i-cy'cloid-al Mil'ling En'gine. A machine for forming templates to be subsequently used as guides in shaping the cutters for gear-cutting machines. In these machines it is essential that the contour of the milling cutter conform precisely to that of the space between two teeth. The machine is somewhat intricate, very ingenious, and is made by *Pratt & Whitney*.

Ep'i-glot'tis Pin-cette'. (*Surgical.*) A long, delicate forceps, having curved prongs with hooked ends for introducing into the epiglottis to remove foreign substances.

Brun's, Fig. 330, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Throat forceps, laryngeal forceps, and probangs for the same purpose, are shown on pp. 82, 83, *Ibid.*

Ep-i-nette'. A chicken-feeding arrangement used in France.

A cylinder with 5 stories and 14 faces, with 3

Fig. 974.

Epinette (Jardin d'Acclimatation), Paris.

compartments each, is mounted on a vertical axis, so that either face may be presented towards the attendant. The box of the attendant (*gaveur*) is counterweighted so that he can bring himself and his feeding apparatus opposite either of the stories. The capacity is 210 fowls.

On the box of the operator is the feed cylinder, the contents of which are ejected by pressure upon a pedal; a dial shows the amount of food passing. The *gaveur* seizes a chicken by the head, presses upon each side of the beak to open the mouth, introduces the nozzle of the feed pipe, presses upon the pedal and injects the required quantity of food, keeping his eye upon the dial. He then takes the next fowl, completes

the round by turning the cylinder one face, winds himself up to the next story, and so on. Duty: 400 chickens per hour. The time required for fattening: chickens, 18 days; geese, 20; ducks, 15; turkeys, 25. Food is a thin paste of barley and corn meal mixed with milk and water. Quantity from 10 to 20 centiliters = 0.7 to 1.4 of a gill at a feed, the maximum being gradually reached.

Epinette on a smaller scale . . * "*Sc. Am. Sup.*," 1295.

Ep'i-la-ting For'ceps. (*Surgical.*) The instrument for transplanting hairs in the skin-grafting process.

Piffard's, Fig. 85, Part V., *Tiemann's* "*Armamentarium Chirurgicum.*"

E-pi-stax'is In'stru-ments. (*Surgical.*) Instruments to avert bleeding of the nose. Among such are the following: —

Nasal clamp.	Rubber tampon (inflatable).
Epistaxis plug.	Laryngeal and posterior nares syringe.
Nasal douche.	Rhinoscope.
Canula.	

E-prou-vette'. An instrument for testing strength of cartridge heads by explosion of powder, is shown in Plate XXIV., Report on "*Metallic Cartridges*," by Major Treadwell, U. S. Army, 1873.

See also article *Poudre*, Figs. 2194, *bis et ter*, *Laboulaye's* "*Dictionnaire*," iii.

E'qual-bar Nest Spring. (*Railway.*) A multi-coil spring in which each coil has a resistance proportioned to its diameter. *S*, Fig. 1143, p. 483, "*Mech. Dict.*"

E'qual-i-zer. 1. A three-horse evener, to throw the strain equally upon three horses abreast.

The illustration, Fig. 975, shows American, British, and French forms, in the order named.

Fig. 975.

Equalizers.

2. An arrangement to divide the strain on all the levers of a horse-power; connecting all the horses together, so that if one pair should make a sudden pull, it draws upon the other horses instead of upon the power, and so does not transmit the irregularity of motion to the machine driven.

E'qual-i-zing Bar. (*Railway.*) A bar, the ends of which rest upon the upper boxes of the axle bearing, and upon which rest the springs supporting the truck frame, seen at *f*, Fig. 1159, p. 488, "*Mech. Dict.*"

E-qua'tion Ap'pa-ra'tus. Electric apparatus for determining the personal equation of astronomical observers is described in *Comte du Moncel's* "*Exposé des Applications de l'Électricité*," iv. 294, 3d edition.

Professor Langley's apparatus for eliminating personal equation by suitable devices during the act of observation, is described in the "*American Journal of Science and Arts*," and reproduced in "*Scientific American*," xxxvii. 170.

E'qua-to'ri-al. A telescope mounted for adjustments in altitude and azimuth; clock-work gives the motion in right ascension.

Reflector (mirror 0.80 m.), by Foucault, at Marseilles, * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iv., ed. 1877, article "*Instruments d' Optique*," Fig. 37.

Telescope, 8″, Grubb, Br. . * "*Engineering*," xxviii. 278.
Vienna . . . . . * "*Engineering*," xxx. 425.
27″, Vienna . . . . . * "*Engineering*," xxix. 7, 200, 310, 391, 409, 467.
Stand, home-made, *Simonton* * "*Sc. Amer. Sup.*," 1241.

E'qui-bus. A name applied to a proposed form of carriage, which spans the horse, and has two wheels.

"*Scientific American*" . . . . . * xxxviii. 265.
"*Manufacturer and Builder*" . . . . * x. 115.

E'qui-lat'e-ral Prism. (*Optics.*) An equal angled prism mounted upon a stand, and used for throwing oblique light upon an object under examination with the microscope.

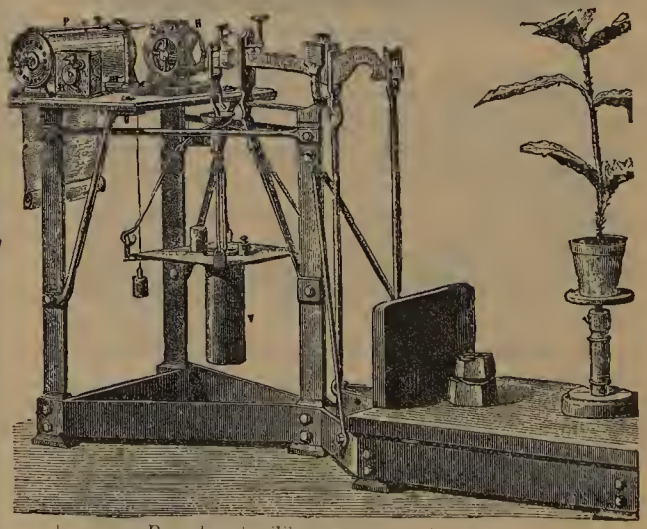
E'qui-lib'ri-um. Equilibrium cock. See EQUILIBRIUM VALVE.

Equilibrium balance. See EQUILIBRIUM SCALE

Equilibrium couch, *Anderson*, Br., * "*Engineer*," xliv. 42

E'qui-lib'ri-um Scale. A scale which keeps itself in constant equilibrium, and records all changes in the weight of the object, such as the growth of a plant, the evaporation of soil or of plants, the waste of tissues on the living subject in breathing, reading, etc.

Fig. 976.



Bascule a équilibre constant. (*Redier, Paris.*)

On a stand next to the platform are placed the registering cylinder, the clock-work, which rotates slowly, and the double wheel-work, which determine the state of constant equilibrium. The principle by which the equilibrium is restored, as soon as it has been disturbed by some cause or other, is this: If we place on an ordinary balance a glass full of water, counter-balanced by a weight, and if we dip into that glass a mass, whatever it may be, hanging from a thread, the equilibrium will be destroyed; in proportion as the plunger penetrates more or less into the liquid, it will more or less disturb the equilibrium. It is such a plunger which Mr. Hervé Mangon has made use of to establish the state of constant equilibrium on the platform scale in question.

Under the little platform of the instrument is a cylindri-

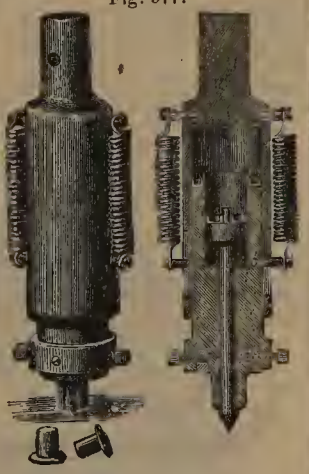
cal vase, three fourths filled with water; a cylindrical plunger, of which the supporting thread is rolled over a pulley, is lowered or hoisted by the wheels of the pulley as soon as the large platform experiences any augmentation or diminution of weight. The equilibrium restores itself immediately, and the motions of the pulley are transmitted to the lead pencil which passes over the surface of the registering cylinder, leaving on the unrolled paper traces of all its movements. The wheels of the pulley are the same as those used in the registering barometer of Redier; the one goes constantly to the right, with an escape; the other to the left, with twice the speed of the first, and the extremity of the balance, by its motions, determines the freedom of the fan of the second wheel-work, which makes the pulley turn in the desired direction.

"*Manufacturer and Builder*" . . . . . * x. 205.

E'qui-lib'ri-um Tool. A drilling or boring tool for metals; having a center steadying pin and a ring of cutters which make an annular groove.

The case holding the cutters is a hydraulic cylinder which is fitted into the drilling-machine spindle socket, being, in fact, an annular ram carrying cutters, inside of which is a steadying pin, with a piston at its upper end working in the cutter ram. The cylinder is charged with soapy water, and when the tool is at rest the cutter ram is kept up by two exterior springs, and the center pin is full out. When the center pin is placed on the center-pop the pressure is transferred by the piston to the outer ram with the cutters, and when the pressure is withdrawn the cutters again retire, being elevated by the springs.

Fig. 977.



Equilibrium Tool.

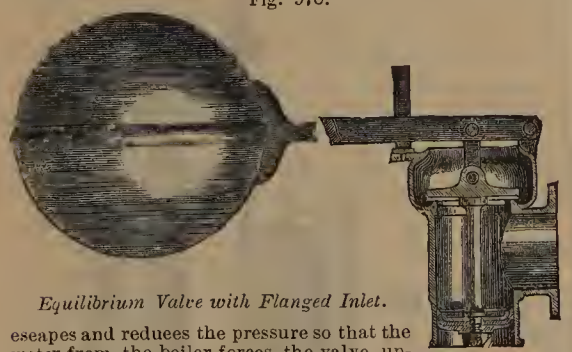
E'qui-lib'ri-um Valve. 1. A valve in which the pressures on the respective sides are in equilibrio; this much decreases the labor of moving them, especially in large stop valves of water mains.

Bogshaw & Sons (Br.), equilibrium sluice valve has balancing pressures above and below, the escapes being bi-lateral.

"*Scientific American Supplement*" . . . . . * 1472.

Booker's (Br.), equilibrium blow-off cock, has a small valve in the center of the larger one. The former being easily and promptly lifted by a quick screw, the water above the valve

Fig. 978.



Equilibrium Valve with Flanged Inlet.

escapes and reduces the pressure so that the water from the boiler forces the valve upward and opens the outlet. Conversely, by closing the small valve the operation is reversed.

"*Scientific American Supplement*" . . . . . * 1441.

Fig. 978 is an equilibrium ball valve for boilers with equal pressure upon the inner faces of the two valves upon the same stem.

2. The equilibrium valve in the Cornish engine opens a communication between the top and bottom of the cylinder, to render the pressure equal on both sides of the piston, Fig. 1884, p. 808, "*Mech. Dict.*"

See also article "*Tiroirs Équilibrés*," * *Laboulaye's* "*Dict. des Arts et Manufactures*," iv., ed. 1877.

E-quip'ment. (*Railways.*) The running stock to make up a train. The passenger train equipment includes the baggage, mail, express cars, and passenger coach; with parlor coach or sleepers in many cases.

E-rect'ing Glass. (*Optics.*) A tube with lenses placed in the draw tube of the microscope to erect the image of the object under view. See DRAW TUBE.

Erg. (*Electricity.*) The unit of work done by one *dyne*. — *Gordon.*

Es-cape'ment Reg'u-la'tor. A contrivance of Breguet in which the escapement is controlled by a tuning-fork.

Fig. 979.

Lister's Erecting Glass

The tuning-fork is about a foot long, and gives one hundred vibrations in a second. About midway upon one of the prongs there is a sliding-weight, by which the number of vibrations can be regulated. Projecting from the end of the prong is a small pin, which acts in the fork of a lever. The lever makes one hundred vibrations in a second, corresponding to the tuning-fork. Attached to this lever is a pair of pallets, which act upon an escapement-wheel having ten teeth, and making four revolutions in a second. The tuning-fork in this case regulates the speed of the train. The pallets and escapement-wheel act in a manner similar to the escapement of the striking-train in a repeating-watch. It was found by experience that the vibrations of the fork should be confined to about one degree to give the best results. These vibrations are so completely isochronal that an increase of power, from 4 pounds to 60 pounds on the train, made no difference in its time-rate. The second-hand made a complete revolution in one second. The dial being divided into one hundred parts, with a proper contrivance for starting and stopping, it might be of service in recording time to the hundredth part of a second. — *Carpenter.*

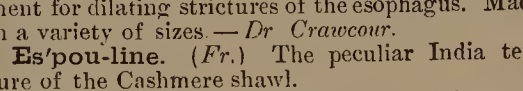
E'so-pha'ge-al Ins'tru-ments. (*Surgical.*) The term includes: —

Throat forceps	Throat lancet.
Throat scoop.	Dilator, etc.
Probang.	Sponge holder.

See list under surgical instruments, "*Mech Dict.*," *et infra.*

E-soph'a-gus Bou'gie. A spiral flexible instru-

Fig 980.



Esophagus Bougie.

ment for dilating strictures of the esophagus. Made in a variety of sizes. — *Dr Crawcour.*

Es'pou-line. (*Fr.*) The peculiar India texture of the Cashmere shawl.

Es-ther'mo-scope. An instrument invented by J. W. Osborne, of Washington, D. C., a thermoscope of peculiar construction to give expression to the aggregate of the climatic influences which tend to affect the normal temperature of the body.

See Fig. 6368, p. 2530, "*Mech. Dict.*" Also paper by Mr. Osborne in the "*Proceedings of the American Association for the Advancement of Science*," Detroit meeting, August, 1875. See also CLIMATOMETER, p. 200, *supra.*

Es'the-si-om'e-ter. See ÆSTHESIOMETER.

Etched E-nam'el. (*Glass.*) A process of ornamenting glass by laying the enamel on the surface in the form of paste, and then etching it into designs or patterns by means of tools.

Etch'ing. (*Glass.*) Etching on clear and dead white ground is done by means of hydro-fluoric acid.

Combined with modern photographic processes which allow copies of prints to be thrown upon grounds, reproductions may be made at slight expense and of remarkable beauty.

Etching on glass . "*Scientific American*," xxxv. 199.
"*Scientific American*," xlii. 149.

A fluid made by *Kessler* of Paris, is used with a common pen in etching on glass. Shown at Paris in 1878. *Kessler* is said to be the inventor of etching on glass in depolish with fluoric acid.

For steel: concentrated acid	40
Absolute alcohol	10
Nitric acid	10
	60
Or: dissolve soda	20
Iodide of potassium	50
In water	400
	470
For copper: fuming nitric acid	100
Water	700
Add a boiling solution of chloride potassium	20
In water	200
For zinc: crushed galls	40
Water	560
Strain and add nitric acid	2
Hydrochloric	3 — *Herrburger.*

For Fichtner's etching proc., see "*Sc American*," xxxiv. 200.

(*Ceramics*) A mode of ornamenting ware in which the glazed surface is covered with a varnish, the pattern etched with a point, the exposed glaze "bitten" with fluoric acid, the varnish removed, the etched lines filled with some strong color or gold, and, finally, the piece re-fired; the glaze softening covers and holds the color.

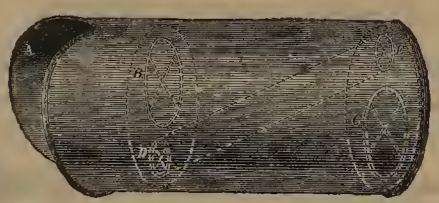
Practiced by Mr. W. Goode, and exhibited by Minton, at Paris Exposition, 1878.

E'ther In-ha'ler. (*Surgical.*) For administration of the vapor of ether as an anæsthetic.

Squibb's, Allis's, Chisolm's, Cheatham's, Speir's, Morton's, Junker's, Figs 400–406, pp. 115–118, Part I., *Tiemann's* "*Armamentarium Chirurgicum.*"

See also p. 1184, "*Mech. Dict.*"

Fig. 981.



Ether Inhaler.

Fig. 981 is Dr. Morton's ether inhaler. It has a gaping mouth-piece, *A*, and valves *B C* to allow air to pass through the sponge chamber. Also valves *D E* for direct passage of air through the instrument without being impregnated with ether. This valve is used when the breathing becomes stertorous, and obviates the necessity of removing the instrument from the mouth.

Eu'di-om'e-ter. A gas testing apparatus. See EUDIOMETER, p. 810, "*Mech. Dict.*"

Gas testing apparatus, or eudiometer test.
"*American Gas-light Journal*" . . * July 3, 1876, p. 3.
See also FIRE-DAMP TESTER; GRISOUMETER, *infra;* COAL GAS TESTER, *supra*, and references *passim.*

Eus-ta'chi-an Ca-nal' In'stru-ments. (*Surgical.*) For treating the canal. Air bag for inflating the canal. See AIR BAG.

Inhaler for forcing vapors into the canal.
Eustachian spray instrument.
Eustachian catheter.
Nose clamp for holding the catheter.

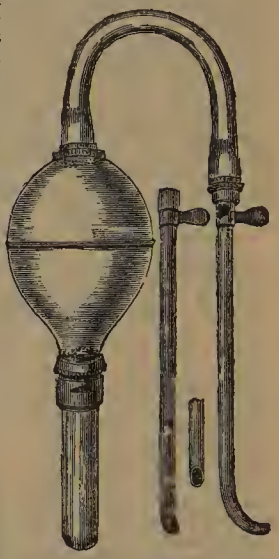
Eus-ta'chi-an Tube Cath'e-ter. (*Surgical.*) A tube for following the course of the eustachian tube, acting as a dilator and discharger.

E-vac'u-a-ting Ap'pa-ra'tus. (*Surgical.*) An instrument for discharging the debris of calculi after lithopaxy, Fig. 982.

Bigelow's instrument consists of a large catheter, preferably straight with a distal orifice, the extremity of which is shaped to facilitate its introduction and during suction to repel the bladder wall. The elastic exhausting bulb acts partly as a siphon. Below the bulb is a glass receptacle for débris.

Fig. 983 shows Dr Joseph Warren's vermicular pointed evacuating tube. Its shape facilitates introduction, as it rotates when passing through the urethra.

Fig. 982.



Bladder Evacuating Apparatus

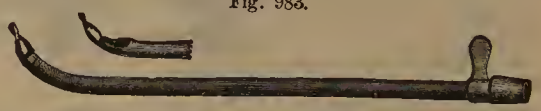
E-vap'o-ram'e-ter. An instrument for determining the evaporation at a given place.

It consists of a flat vessel of known area and capacity, in which rain, etc., is collected, and which is either measured or weighed to determine the loss by evaporation.

The apparatus shown at Fig. 1892, p. 813, "*Mech. Dict.*," is perhaps better adapted for reservoir, river, or tide gage and recorder, than strictly for the purpose of an evaporameter.

Erkman, of Stockholm, Sweden, showed at the Centennial Exhibition in 1876 a portable evaporameter, and a fixed one resembling that in use at the Käringö Station in the Skager Rack, where the wind has free access from all quarters. These evaporameters are circular, shallow, straight-sided cisterns of Portland cement, showing a surface of 50′ square (Swedish). The observer has to register not only the linear sinking of the surface, but also the quantity of water which in

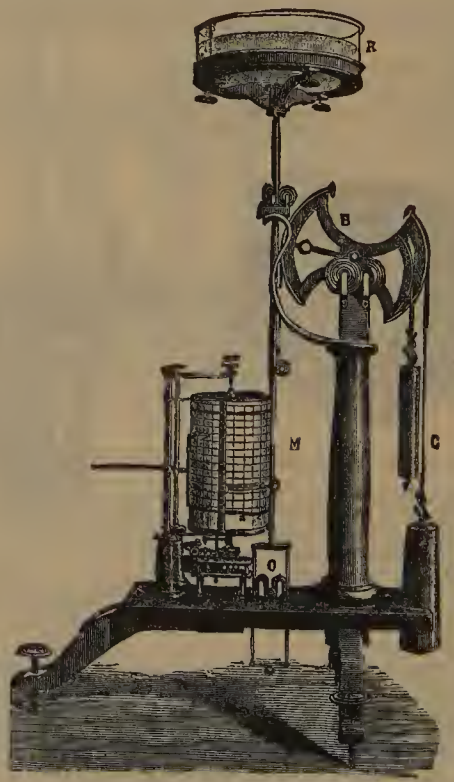
Fig. 983.



Evacuating Tube.

the course of the year is poured into or drawn off from each evaporameter. A small channel at the bottom is provided

Fig. 984.



Ragona's Registering Evaporameter

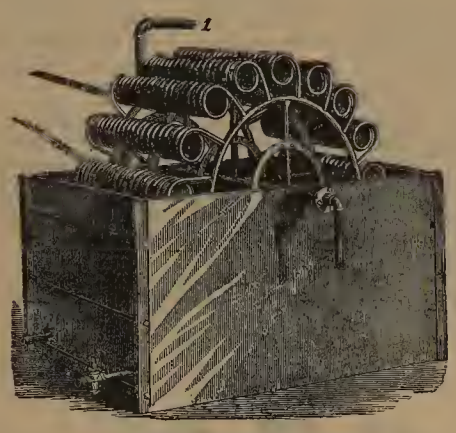
for the latter purpose. The tests for height of water are by a graduated tubular glass stem, or a plunger rod.

The registering evaporameter of Sig. Ragona, director of the Modena Observatory, consists of a glass vessel, *R*, Fig 984, containing water; it is placed on the platform of a balance of which the arm is represented by *B*. A counterpoise suspended by the cord *C* holds the vessel in equilibrium; but this equilibrium is equitable, as the contents of the vessel are continually diminishing by evaporation, so a second counterpoise, adapted to an eccentric, is disposed (as shown in the figure) in such a way as to support the vessel while it diminishes in weight. This counterpoise does not prevent the vessel containing water from rising with the rod *M*, which supports it, in proportion to its diminished weight. While ascending, the rod *M* carries with it a lead pencil, which traces a curve on the surface of a paper cylinder, which is rotated slowly by means of the clock-work *O*.

E-vap'o-ra'tor. See illustrations of many forms in "*Mech. Dict.*," * pp. 811–813.

Badoux's evaporator has a wheel made of circulating tubes and carrying series of coils which dip into the liquid and raise it to be evaporated by the air. It exposes a greater surface than *Schroder's*, shown at D, Fig. 1887, p. 811, "*Mech. Dict.*" They both act upon the same principle. The *Badoux* evaporator is used in sugar and glue work.

Fig. 985.



Badoux's Evaporator.

Cook's,* with portable furnace. *Mallet's* Report on Group III., vol. iv., "*Centennial Exhibition Reports*," p. 55.

Badoux's evaporator, *Ibid.*, p. 56.

Rillieux's and Cail's apparatus for sugar-house, see *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Evaporateur*," tome iv., ed. 1877.

App. for salt, *Piccard*, Fr., * "*Sc. Amer. Sup.*," 2336, 2448, 3982.

Moistening air, *Parmenter*, * "*Iron Age*," xix., April 12, p. 7.

E'ven Scales. Scales, the beam of which is suspended at mid-length, so that the poise and the object are of equal weight.

E-ver'sion Ap'pa-ra'tus. (*Surgical.*) 1. Feet eversion apparatus. See CLUB-FOOT APPARATUS; CURVATURE APPARATUS.

2. *Entropium forceps;* also called *Trichiasis forceps*, Fig. 1877, p. 805, "*Mech. Dict.*"

Ex'ca-va'ting Pump. 1. A form of dredging machine in which the water pumped draws up with it silt, mud, sand, etc., from a bar or shallow river bottom. See DREDGE.

2. A vault emptier, Fig. 584, p. 187, *supra.*

Ex'ca-va'tor. A dredge, digger, scoop, borer, pump, as the case may be. See p. 814, "*Mech. Dict.*"

See also the following references: —

Ball . . . . . "*Min & Sc. Pr.*," xxxvi. 49.
Calais Harbor . . . . . * "*Engineer*," xlix. 405.
* "*Sc. American Sup*," 3787.
Chaplin, Steam, Br. . . . * "*Engineer*," xlii. 378.
* "*Sc. American Sup.*," 1009.
"*Van Nostr. Mag.*," xvi. 288.
Courreux, Danube . . . . * "*Sc. American Sup.*," 314.
Diack, borer and bag, Japan * "*Engineer*," xliv. 291.
* "*Sc. American Sup.*," 1631.
Dunbar & Ruston, Steam, Br. * "*Engineering*," xxiii. 360.
* "*Sc. American Sup.*," 1378.
Fouracres, India . . . . . * "*Engineering*," xxviii. 153.
Fowler, scoop, Br. . . . . * "*Engineering*," xxv. 446.
* "*Sc. American*," xxxix. 51.
Kind-Chaudron, Belgium . * "*Sc. American Sup.*," 1296.
Ghent ship canal . . . . * "*Engineering*," xxvi. 314.
* "*Sc. American*," xxxix. 367; xl. 54.
Price . . . . . * "*Min. & Sc. Pr.*," xxxiv. 347.
Priestman, Br. . . . . * "*Engineer*," l. 74.
Reeves, pump . . . . . * "*Sc. American*," xxxviii. 8.
* "*Sc. American Sup.*," 1617.
Ruston & Procter, Br. . . . * "*Engineer*," xliii. 80.
* "*Sc. American Sup.*," 1075.

Ex-change'. (*Telephone.*) A central office in which the wires of any two telephone stations are connected, on call of either.

Ex-ci'sing For'ceps. (*Dental.*) Gnawing forceps, for cutting off projecting parts of carious teeth.

Fig. 986.

Straight Beak Excising Dental Forceps.

Ex'er-ci-sing Ma-chines'. The Centennial Exhibition of Philadelphia, 1876, and the Paris Exposition of 1878, had remarkable, varied, and ingenious appliances for the exercising of the muscles of the body.

The Mechanico-Therapeutic Institution, of Stockholm, established by *Dr. G. Zander* in 1836, led the way in the variety of its apparatus, a part only of which was shown in Philadelphia. The full set consists of 67 machines.

17 machines for active arm movements.
18 machines for active leg movements.
9 machines for active body movements.
23 machines for passive movements.

The passive movements are worked by a steam-engine, and consist of movements as follows, applied to body, head, limbs, abdomen, etc.: —

Shaking.	Rubbing.
Chopping.	Swinging.
Tapping.	Balancing.
Kneading.	Expansion of the chest.

The Mechanico-Therapeutic Institution is open from the 1st of October to the 1st of June, 4½ hours daily for gentlemen, and 2 to 3 hours for ladies. Every patient receives a prescription in which the movements to be performed are enumerated, and the number of the graduated scale of the machine corresponding to the force or the need of the patient is fixed. 12 movements are generally performed daily; after 12 days all or a part of the movements are changed according to the nature of the case treated.

The following is from a spectator: "One machine, when its handles are grasped by the patient, twists the arms; another exercises the flexor and extensor muscles of the wrist, a third pulls the arms back; a fourth exercises the knee muscles; a fifth exercises the muscles which carry the leg outward; and a sixth exercises the ankle muscles. On the seventh the patient lies down and is shaken up so that the extensor muscles of the back are exercised. Another machine is very complicated, and calculated to excite some dismay in the patient, whose 'thorax is pulled upward by means of two levers, while a pad makes a horizontal pressure on the back. The trunk is thereby elongated a few inches, and the spine and walls of the chest are stretched.' There is something about all this dismally suggestive of the rack. In another machine the patient is put through all the misery of horseback riding without any of the accompanying pleasures. He is seated on a saddle, and the latter then becomes possessed of a desire to shake him off. 'This causes the abdominal viscera to be kneaded and rubbed together against each other and the abdominal walls.' There is still another machine, consisting of a couple of wheels having peripheries of padded bars. These, when revolved, serve to warm the feet, the latter being pressed against them. Lastly there is a hammering machine, which has a number of vertical beaters which are set in rapid vibration, so as to hammer the patient in the small of the back or at any desired point."

Another elaborate display in Paris was from the Grand Gymnase of Eug. Paz. The apparatus is very complete, each

of the 14 machines being capable of many different applications (Eugène Paz, 34 Rue des Martyrs, Paris).

Ex-haust' Cham'ber. A chamber in the smoke-box of a locomotive, so placed as to prevent the unequal draft of the tubes. A modification of the *petticoat pipe*. *Pollock & Williams.*

"*Scientific American Supplement*" . . . . . * 2236.

Ex-haus'ter. An aspirator, exhaust-fan, suction-fan, known by many names according to construction or purpose.

For planing mills . * "*Manuf. and Builder*," ix. 125–129.

Ex-haus'ter Gov'er-nor. (*Gas.*) An arrangement for governing the speed of a gas-exhauster engine by the pressure of the gas within the governor, *i. e.*, the governor is self-acting, the make of gas being made to regulate the speed of the engine. When the charges are being drawn from the retorts the production is small and the speed of the engine reduced. When the gas is generated rapidly the pressure of the gas increases the speed of the engine. See GAS EXHAUSTER, and citations *passim*.

Ex-haust' Noz'zle. Shaw's quieting arrangement for exhaust nozzles of locomotives is shown in Fig. 987. The lower end is screwed to the safety-valve pipe, the upper is closed with a cap; the sides are bored for numerous small tubes to equal in their sum the total outlet required. The effect is to prevent the loud sound of escaping steam.

Fig. 987.

Quieting Blast Nozzle.

Brainerd's exhaust nozzle for locomotives has a sleeve upon the nozzle pipes to confine the steam to issue axially and create full draft through the cone beneath or by opening side ports to deflect the relief steam into the cone chamber and decrease the effectiveness of the draft.

"*Scientific American*" . . * xxxviii. 98, 262.

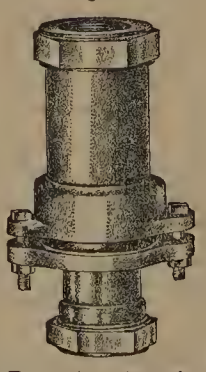
Ex-haust' Pu'ri-fi-er. A machine for sorting grain, or purifying middlings by a *suction draft*, as distinct from a *blower*. An *aspirator*, which see.

Ex-hi-bi'tion. The following figures are given as to the number of exhibitors and visitors on the occasions named: —

		Exhibitors.	Visitors.
London . .	1851	13,917	6,039,195
Paris . .	1855	23,954	5,162,330
London . .	1862	26,653	6,211,103
Paris . . .	1867	50,236	8,805 969
Vienna . .	1873	20,205	6,740,500
Philadelphia	1876	–	9,857,625
Paris . . .	1878	–	16,159,719

Ex-pand'ing Chuck. A chuck, the jaws of which are opened or closed to admit objects of varying sizes. See DRILL CHUCK for instances, though other chucks have similar adjustment.

Fig. 988.



Expansion Pipe Joint.

Ex-pand'ing Cul'ti-va'tor. One with hinged bars, capable of being spread apart at the rear, so as to adjust the width of tilth.

Ex-pan'sion En'gine. A steam engine working steam expansively. The invention of *Wolff*. See CUT-OFF; EXPANSION VALVE.

Ex-pan'sion Hang'er. A suspended hanger for radiator pipes, permitting the changes in length due to expansion by heat.

Ex-pan'sion Joint. A slip joint, to allow the contraction or extension of tubes incident to the changes of temperature. Applied to coils or lines of steam, hot water, or condenser pipes.

In ordinary instances, it has a cast-iron body, with brass sleeve and screw ends.

Ex-pan'sion of Met'als Ap'pa-ra'tus. An instrument devised by Prof. A. M. Mayer, of Stevens Institute, for the purpose of determining experimentally the co-efficient of expansion of metals and alloys.

The bar, whose co-efficient of expansion is to be determined, is supported on standards in a brass tube, which is made about $\frac{1}{4}$" shorter than the bar. Against the ends of the bar are placed rubber washers, which are perforated so as to allow the ends of an abutting screw and a rod connecting with the moving mirror of the comparator to come in contact with the ends of the bar. Arrangements are provided which hold the washers perfectly water and steam tight against the ends, while the bar is perfectly free to expand or contract in the tube. Inside the tube are supporting springs, which relieve the standards in some degree from the weight of the bar.

"*Scientific American*" . . . . . * xxxvii. 351.

See also DEFLECTOMETER, p. 249, and reference there cited.

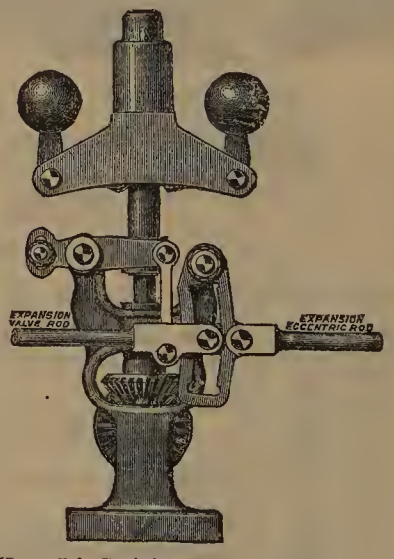
Ex-pan'sion Valve Gear. An automatic apparatus to cut off live steam from the cylinder at any required portion of the stroke.

The Corliss system has been very largely adopted in this country and in Europe, and, to follow the words of M. de Wilde, may be defined —

"As consisting of an assemblage of parts, acting as one upon the cylinder valves under the impulse of an eccentric or cam, while the governor of the engine at the desired moment causes the separation of the assemblage into two distinct portions, of which one continues to obey the action of the eccentric or cam, while the other, which is in immediate contact with the valves, escapes from its influence and closes the steam-port."

Hartnell's expansion-valve gear consists of a sensitive governor acting through a link and die upon an expansion cut-off valve working at the back of the main slide valve, the ordinary throttle valve is dispensed with, and the speed of the engine controlled by means of the expansion valve which regulates the admission of steam into the cylinder exactly in proportion to the duty performed by the engine.

Fig. 989.



Hartnell & Guthrie's Expansion-valve Gear.

See also CUT-OFF, *supra*.

Ashworth	* "*Sc. Amer. Sup.*," 438.
Berghof, Hungary	* "*Engineering*," xxix. 35.
Brown, Br.	* "*Engineering*," xxx. 271.
Calow, Ger.	* "*Engineering*," xxx. 483.
Crohn, Br.	* "*Engineering*," xxi. 516; * xxx. 179.
Collmann, Ger.	* "*Engineering*," xxiv. 472.
De Negri	* "*Engineer*," xlviii. 451.

Galloway, Br.	* "*Engineer*," xlvi. 241.
Guinotte, Fr.	* *Thurston's* "*Vienna Rept.*," iii. 63.
Hartnell, Br.	* "*Engineering*," xxii. 474.
Joy, Br.	* "*Engineer*," 1. 114.
	* "*Engineering*," xxx. 179.
Kaiser, Br.	* "*Engineering*," xxx. 271.
Knuttel	* "*Engineering*," xxx. 348.
Marshall, Br.	* "*Engineering*," xxx. 127, 271.
Melvin, Br.	* "*Engineering*," xxx. 149.
Proell, Ger.	* "*Engineering*," xxix. 416.
Rigg, Br.	* "*Engineer*," xlvi. 423.
Thompson, "Buckeye"	* "*Engineer*," xlii. 262.
Winding engines, Essen	* "*Engineering*," xxx. 258.
Walschaert, Belg.	* "*Engineering*," xxx. 159.
Weatherhogg, Br.	* "*Engineering*," xxii. 362.
	* "*Sc. American Sup.*," 962.
Zimmermann-Waldmann, Ger.	* "*Engineering*," xxx. 205.

Lemounier & Vallée (Fr.) * *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," vol. iv., ed. 1877, article "*Détente, Soupape à.*"

Ex-pan'sive Hol'low Au'ger. One having an adjustability for cutting round tenons of varying sizes. See page 185, "*Mech. Dict.*"

Ex-plor'ing In'stru-ment. 1. (*Surgical.*) A diagnostic instrument, various in kinds and applications. For instances: —

Eustachian canal	Fig. 189, Part II.
Exploring trocar	Fig. 181 *c*, Part III.; 288–290, Part I.
Small trocar and acupuncture for rectal explorations	Fig. 608, Part III.
Uterine probes and sounds	Page 73, Part III.
Bougies for exploring urethral strictures	Page 9, Part III.
Exploring director for bistouries	Page 135, Part I.

All in *Tiemann's* "*Armamentarium Chirurgicum.*"

See also Bullet Seeker; Probe; Sound; Bougie, etc.; see List under Surgical Instruments, "*Mech. Dict.*," *et infra.*

2. (*Dentistry.*) A fine-pointed probe, right, left, straight, bent, bayonet-shaped, etc., for testing the depth or existence of caries in teeth.

Ex-plo'sion Ma-chine'. A motor which depends for its force upon the explosion of substances generating a gas which is used under pressure in an engine or apparatus.

Several gunpowder engines are noticed on p. 1041, "*Mech. Dict.*"

The gunpowder pile-driver on same page.

The gas engines on pages 948, 949, *Ibid.*

See also Gas Engine, *infra.*

Laboulaye's "*Dictionnaire*," ii., article "*Explosion*," mentions *Brown's* machine, 1830, and that of *Selligue*, 1834; the latter for moving boats without the intervention of mechanism, the gases issuing at the stern and impinging on the water.

Ex-plo'sives. These may be classed generally as follows: —

Gunpowder.
Gun cotton.
Nitro compounds:
  Nitro-cellulose.
  Nitro-glucose.
  Nitro-starch.
  Nitro-glycerine and its compounds.
Picric acid:
  A triuitro-phenol.
Fulminates:
  Fulminating mercury.
  Fulminating silver.
  Chlorate of potassium and sulphide of antimony; needle-guns of Germany.
  Sulphur and chlorate of potassium.
  Red phosphorus and chlorate of potassium. *Armstrong's.*

The mixture of nitro-glycerine with dry pulverized absorbent substances has given rise to a variety of explosives of which the name *dynamite* is perhaps generic. The following names have been given to various compositions, or the article furnished by various manufacturers. Many of these names are found in their alphabetical places in the present volume. The difference between the articles is largely in the proportions of the materials: —

Dualin.
Giant powder.
Hercules powder.
Jupiter powder.
Lignose.
Mica powder.
Neptune powder.
Potentia powder.
Rendrock.
Sebastine.
Thunderbolt powder.
Titanite.
Titan powder.
Vigorite, etc.
Vulcan powder.

The report of the United States Board of Army Engineers presents the following table as the result of two years' trial of the relative efficieucy of the various modern explosives, taking ordinary dynamite as the staudard: —

Dualin	111
Hercules powder, No. 1	106
Dynamite, No. 1	100
Rendrock	94
Guu cotton	87
Dynamite, No. 2	83
Hercules powder, No. 2	83
Mica powder	83
Vulcan powder	82
Nitro-glycerin	81

To which may be added for comparison: —

Blasting gunpowder, No. 1	30

See also table by Bertholet on p. 818, "*Mech. Dict.*"

Explosive by Prof. Emerson Reynolds, Dublin: —

Chlorate potassium	75
Sulphurea	25

The latter is a product of gas manufacture.

The articles may be stored and carried separately without auy danger, and the article produced instantaneously by a comparatively rough mixture of the components.

See *Abbot's* report "*Centennial Exhibition Reports*," vol. vi., Group XVI., p. 52 *et seq.* Including: —

Nitrates.
Chlorates.
Gun cotton.
Fulminates.
Pebble and pellet powder.
Nitro-glycerine.
Picrates.

Dussauce's "*Treatise on the Fabrication of Matches, Guncotton, and Fulminating Powder.*"

Burgoyne, "*Blasting and Quarrying of Stone, and Blowing-up of Bridges.*"

Cf: Exploders, etc., Austrian	* "*Engineering*," xxvi. 369.
Explosives, paper by C. Rice	"*Scientific Am. Sup.*," 2329.
Comp. energy of	"*Man. & Builder*," xii. 206.
Comparative values, *Drinker*	"*R. R. Gazette*," xxii. 14.
	"*Sc. Amer.*," xxxiv. 2, 102; xxxviii. 210; xxxix. 191, 360; xl. 259; xlii. 276.
	"*Sc. Am. Sup.*," 134, 2018, 3874.
	"*Eng. & Min. J.*," xxv. 346, 361.

See under the following heads: —

Azotine.
Blasting gelatine.
Breaking-down machine.
Carbo-azotine.
Cube powder.
Diorrexine.
Drying house.
Drying stove.
Dualin.
Dusting machine.
Dynamite.
Explosive gelatine.
Gelatine, blasting.
Glazing barrel.
Granulated-wood powder.
Granulating machine.
Gravel powder.
Gun cotton.
Gunpowder.
Gunpowder machine.
Ilerakline.
Jelly powder.
Johnite.
L. S. G.
Lignose.
Nitro-gelatine.
Nitro-glycerine.
Papyroxyline.
Pebble powder.
Pebble-powder machine.
Pellet powder.
Pellet-powder machine.
Petralite.
Potentite.
Poudre brutale.
Powder dusting machine.
Powder paper.
Powder-pressing machine.
Priming machine.
Prismatic powder.
Pyrophore.
Pyrophorus.
Pyroxyline.
Saltpeter and sulphur-grinding mill.
Saltpeter, sulphur, and charcoal mixing mill.
Sebastine.
Squib.
Tonite.
Vigorite.
Vulcan powder.

Ex-plo'sive Bul'let. Two explosive bullets are mentioned under Bullet, p. 401, "*Mech. Dict.*" These were intended for war, but the military service of civilized nations has not been disgraced by their use to any extent.

Fig. 990.

Explosive Shell.

The Dougall explosive bullet for heavy game is made thus: in pouring the bullet a small copper bottle is suspended in the center of the mold, so that it is inclosed by the lead except at the front where a tige holds the bottle and forms the future charging opening. It is charged

with equal parts of sulphuret of antimony and chlorate of potassa, or with common powder, and primed with a fulminate. It is used for elephant, lion, tiger, and alligator shooting especially.

Ex-sec'tion In'stru-ments. (*Surgical.*) Instruments for removing sections of bone by sawing in two places, or by circular incision.

Special bow saw.	Trephine.
Metacarpal saws.	Elevator.
Chain saw.	Raspatory.
Interosseous saw.	Sequestrum forceps.
Circular saw.	Antrum drill.
Chisels.	Rongeur.
Bone drills.	Retractors.
Bone forceps.	Subcutaneous saw.

Ex'sic-ca'tor. A dessicator, which see.

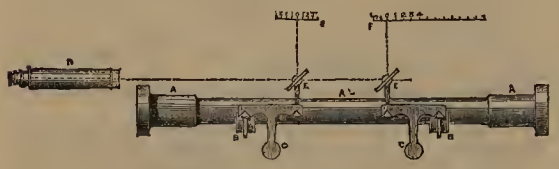
Ex-ten'sion Ap'pa-ra'tus. To extend a fractured limb in order to maintain the coaptation of parts. See COUNTER-EXTENSION APPARATUS; EXTENSION APPARATUS, "*Mech. Dict.*"

Dr. Levi's adjustable-weight leg-extension apparatus. "*Scientific American Supplement*" . . . . . *2101.

Ex-ten'sion Meas'ur-ing Ap'pa-ra'tus. An instrument for measuring minute extensions, deflections, and compressions by means of a multiplying optical arrangement.

A A is the test-piece; *B B* clips on the test-piece carrying

Fig. 991.



Willis's Measuring Apparatus.

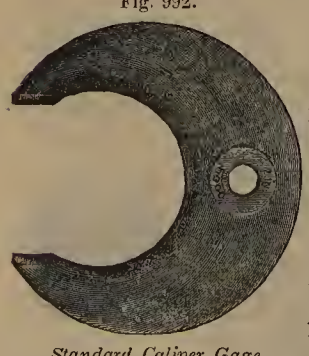
pins; *C C*, weighted drop pieces forming connecting rods; *D*, a telescope fitted with a cross hair; *E E*, two mirrors turning on axes. These have each a line across them for adjustment. *F F* are two scales carried on rails on a beam fixed to the roof, so that they can be adjusted to zero for any length of specimen. In looking through the telescope both scales are seen at once reflected in *E E*, and the figure on each covered by the cross hair is that which is read off for each strain. If both readings alter, the sum of the change is the extension of the bar. The short scale is for the end of the specimen next the lever of the machine, which should not move sensibly, but which does move small amounts due to the take-up of collars, and to differing positions of the steel-yard. The distance from the scales to the mirrors is about 11′. The radius of the levers *G G*, which cause the partial rotation of the mirrors as the specimen lengthens, is about 1⅞″ with the doubling of the angle caused by reflection; this gives a total magnifying power of about 140 to 1. The extension between certain definite points only on the bar is measured which eliminates errors due to the taking up of the bearings of collars, etc. The reading is, by estimation, up to 1-4000″. See also TASEOMETER.

Extension measuring app., *Willis*, Br. *"*Engineer,"* xlvii. 385.

See also EXPANSION OF METALS APPARATUS, p. 320, *supra*.

Ex-ter'nal and In-ter'nal Gages. Standard caliper, ring, plug screw, and nut gages made to exact size and used for measurement and testing accuracy of templates, taps, etc.

Fig. 992.



Standard Caliper Gage.

The system may be said to have originated with Whitworth, but is now carried to great accuracy in several countries. In one case the instruments are of 3 classes, on a scale of precision.

Class *A* guaranteed to 1-25,000″.

Class *B* guaranteed to 1-10,000″.

Class *C* guaranteed to 1-5,000″.

Class *A* adjusted at 75° Fah.; *B* and *C*, 60° to 80°. They have a parallel fit from ⅛″ to ¾″ in length; are arranged by sixteenths of an inch from ⅛″ to 2½″; by eighths to 4″; by fourths to larger sizes. Made also in millimeters.

Fig. 992. External caliper gage for turning: crescent pattern.

Fig. 993 is the flat-bar pattern, internal gage: for boring.

Plain external and internal gages are shown under CYLINDRICAL GAGE, Fig. 772, p. 244, *supra*.

Fig. 994 shows screw-thread gages, external and internal.

Fig. 993.

Standard Internal Gage.

Ex'tir-pa'tion For'ceps. (*Surgical.*) Forceps having on each arm double claws for reaching around and grasping the eye-ball in the operation of extirpation.

Blitz's, Fig. 80, *f*, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Fig. 994.

Screw-thread Gages.

Ex-tract'or. (*Fire-arm.*) The device which withdraws the spent cartridge capsule in the motion of uncovering the breech for reloading.

Ex'tra Cur'rent. (*Electricity.*) The *appreciable* current in the primary coil, which is due entirely to induction.

Eye. (*Add.*) 1. (*Nautical.*) A sheave for a rope; see DEAD-EYE; BULL'S EYE; HEART, "*Mech. Dict.*"

2. (*Vehicles.*) The socket on a shaft or pole which connects with the clip on the axle.

Eye, Ar'ti-fi'cial. A false eye for persons, stuffed animals, etc., and dolls.

Fig. 995.

Pole and Shaft Eyes.

a. Pole eye.
b. Shaft eye.
c. Shaft eye plain.
d. Completed coupling.

The material for the artificial eye is a rod of glass about the size of a pencil. On the end of this a bulb is blown of the size of the eyeball with which it is to match, and having a slight ovality. At the place for the iris and pupil the little sphere is flattened, and a circular patch of black pigment placed in the center to form the pupil. The painting of the iris is a very delicate matter, and the colors and proportion are studied from the sound eye of the patient. With enamel colors from a palette the zone around the pupil is colored, and then a bulb of clear crystal glass is placed over it to form the cornea, flat side down, and is fastened by fusing its edge by the blow-pipe flame. The red veins of the ball are imitated from the sound eye, being fine films of red glass laid on, and subsequently fused. The fitting to the *stump*, as the remaining portion of the ball is termed, is a matter of great nicety.

Eyes for birds, etc., are made in great quantity, both for museums and for the dressing of ladies' hats. Finch, humming-bird, partridge, pheasant, blue creeper (African), and scarlet tanager, are among the most common. Eyes for foxes, stags, rocking-horses, wax figures, prize animals and winners, trophies of the chase, dolls, are also made in large quantities, varying from 1 cent per dozen to 75 cents per pair.

Siemens' sensitive artificial eye, *"*Sc. American,"* xxv. 374.

Eye Bar. An iron bar, with a round eye at each end usually. Much used in iron bridge building. Machine for drilling eyes; Fig. 854, p. 269, *supra*.

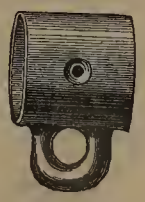
Eye Block. A tackle block with an eye or loop above, for shackle or lashing.

Eye Douche. (*Surgical.*) An apparatus for sending a fine shower of water upon the eye. Agnew's has an elevated pan, hung upon a hook, and a caoutchouc tube with spray nozzle.

Fig. 95, p. 27, Part II., *Tiemann's "Armamentarium Chirurgicum."*
See also Eye Cup, p. 819, "*Mech. Dict.*"

Eye Fer'rule. A thimble with an eye loop. Used with swingle trees, and for many other purposes.

Fig. 996.



Eye Ferrule.

Eye Glass. (*Add.*) A single myopic or presbyopic glass worn in the eye.

A double glass with a spring in a *pince-nez*. See Fig. 1909, p. 819, "*Mech. Dict.*" Also Spectacles, Fig. 5355, p. 2258, *Ibid.*

Blethen's eye-glass.
* "*Scientific American*," xlii. 5.

Eye In'stru-ments. (*Surgical.*) These are for diagnosis and exploration, operation, prothesis. See under the general heads, *b*, *e*, *f*, *g*, *h*; and under the special titles in following list: —

a. Instruments for operating on the lids and lachrymal ducts: —

Entropium forceps.	Depilating forceps.
Trichiasis forceps.	Eye speculum.
Eyelid tourniquet.	Eyelid retractor.
Cilia forceps.	Lachrymal duct dilator.
Eyelid compressor.	Drop glass.
Canalicula dilator.	Lachrymal syringe.
Probe.	Subpalpebral syringe.
Eye syringe.	Lachrymal gouge.
Conjunctiva forceps.	Fistula knife.
Cauterizing canula.	Canalicula syringe.
Bistoury caché.	Needle forceps.

b. Strabismus instruments.

c. Fixation and extirpation instruments: —

Fixation hook.	Extirpation forceps.
Fixation forceps.	Double hook.
Tumor Forceps.	Ophthalmostate.
Pamard's pique.	Lid forceps.

d. Instruments for removing foreign bodies from the eye:

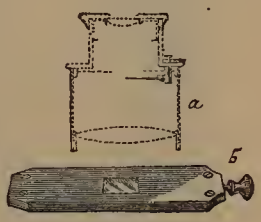
Spud.	Spatula.
Needle.	Curette.
Gouge.	Spoon.
Hook.	Eye douche.
Couching needle.	Forceps.

e. Conjunctiva instruments.
f. Corneal instruments.
g. Cataract instruments.
h. Iris instruments. Iridectomy Instruments.

Eye'let Grom'met. A worked hole in a sail, reënforced by an eyelet. See Grommet.

Eye'-piece In'di-ca'tor. A small pointer with lateral movement in the eye-piece of the top lens, for pointing out any particular portion of an object under view.

Fig. 997.



a. Eye-piece Indicator.
b. Eye-piece Micrometer.

The eye-piece micrometer is adjusted across the line of sight, and its cross markings divide the field into squares of known size.

Eye-piece, microscopic.
* "*Manuf. & Builder*," xi. 37.
Telescopic, *Nystrom.*
* "*Sc. American Sup.*," 101.

Eye Pro-tec'tor. Glasses, goggles, or gauze worn over the eyes.

Smoke, or other colored glasses, to moderate the light; goggles to exclude side light; gauze, to exclude dust and cinders. See Spectacles, p. 2358, "*Mech. Dict.*"
The *coquille* glass is egg-shell shaped.
Millers' and turners' glasses are merely white panes of glass or mica, to protect the eyes from chips. See also Goggles, Fig. 2263, p. 991, *Ibid.* Also Iris Diaphragm, Fig. 2697, p. 1195, *Ibid.*

Eye Shade. (*Optics.*) *a.* A hood or vizor over the eyes to protect from upper light.

Fig. 998.

Eye Shade (*c*).

b. A hood fixed on the eye-piece of a microscope to prevent lateral rays from entering the eye.

c. A piece fitted around the cap of the eye-piece of a microscope, and intercepting the view of that eye which is not in use; in order to prevent the distraction of the attention, or obviate the necessity for the muscular closing of the unused eye.

F.

Fab'ric. (*Fabric.*) A woven or felted goods
The character depends upon the material and the *armure* or character of the weave.
Varieties of armure: —
1. *Taffeta* with 2 harnesses.
2. *Twilled* with 4 harnesses.
3. *Serge* with 3 harnesses.
4. *Satin* with 5 or more harnesses.

Different effects are produced —
By derivatives from these fundamental tissues.
By greater or less torsion of the threads.
By the direction in which the yarns are twisted.
By variations in the relative sizes of the warp and weft threads.
By causing the weft to pass alternately over two threads and one thread of the warp; making a *rep* or corded tissue.
By different materials of warp and weft.
By colors.
By mixtures of materials in the yarn.
By printed threads making *hit-or-miss*, or *mixtures.*
By looping threads, to make *pile* fabrics; and cutting or non-cutting the loops.
By printing.
By dyeing.
By floating the weft to make dots, spots, stripes, or figures.
By character of material, as of soft and fine wools or of hard and lustrous combing wools.
By two or more warps which are brought to the surface as required by the figure.
By setting up bands of colors or varying yarns in the warp to form stripes.
By adding to the last mentioned a similar arrangement in the weft to make checks or plaids.
By combinations of the crossing threads which occur at variable places.

See Aino cloth.	Arras.
Algerine.	Australian crape.
Alpaca.	Baize.
Alpaga.	Barége.
Alpine.	Basket.
Anacostia.	Batavia weave.
Armure.	Baudekin.

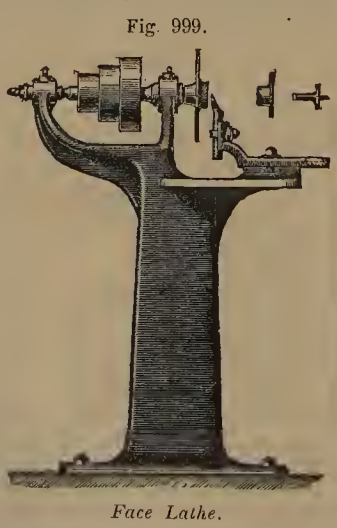
Biaretz.
Bolivar.
Bombazine.
Bourdalisandre.
Brilliantine.
Brocade.
Buckram.
Burlaps.
Calico.
Cambric.
Camel's hair.
Cannel.
Cashmere.
Cashmere de beige.
Challis.
Chambery gauze.
Chinchilla.
Chintz.
Circassienne.
Cordwain.
Cotton.
Cramoisy.
Crape of Spain.
Cretonne.
Cypresse.
Damask.
Debeige.
Delaine.
Diagonal.
Diaper.
Dimity.
Drap d'Alma.
Drap d'Alpes.
Drap d'Nationelle.
Drap d'Été.
Drugget.
Duck.
Empress.
Épengline.
Épinglé.
Frieze.
Fustian.
Gauze.
Gingham.
Grenadine.
Grisaille.
Henrietta cloth.
Hernani.
Imperial silk serge.
Jean.
Jupon.
Kerseymere.
Knickerbocker.
Lindsey-wolsey.
Llanos.
Luster.
Manteau.
Metelasse.
Melango.
Merino.
Merino tulle.
Mexican cloth.
Mohair.
Mohair glacé.
Moire.
Moulleton.
Mousseline.
Mousselin de beige.
Mozambique.
Muslin.
Nankeen.
Palampore.
Paramatta cloth.
Pongee.
Poplin.
Punjaun.
Rayne.
Rep.
Salampore.
Sarsnet.
Satin.
Satine.
Satin weave.
Sendal.
Serge.
Serge armure.
Sicilienne.
Siclatoun.
Sindon.
Taffeta.
Taffetas.
Taffetas armure.
Tamise.
Tamise rep.
Tars.
Tissue.
Toile de Saxe.
Turenne cloth.
Turquoise.
Tusser silk.
Twilled armure.
Valencia.
Velours.
Veloutine.
Velvet.
Vigogne.
Vode.
Worsted.

Face. (*Mining.*) The end of a drift or tunnel.

Face Ham'mer. (*Masonry.*) One with one bluut and one cutting end. The latter used for roughly squaring stones preparatory to the use of finer tools.

Face Lathe. 1. A pattern-maker's lathe for turning bosses, core prints, and other face work. The instance shown works up to 16″ diameter, and stands on 2′ × 2′ on the floor. The spindle is of steel, with brass bearings.

Fig. 999.



Face Lathe.

2. A lathe with a large face-plate and a slide rest adjustable in front on its own shears. Transverse usually but not necessarily.

Fetu & Deliege, Fr. . . . * "*Engineering*," xxix. 117.

Face'-plate. (*Add.*) 2. A covering plate for an object to receive wear or shock.

Fa'cing Ma-chine'. (*Milling.*) A machine for dressing the faces or lauds of mill stones; that is, the spaces between furrows. A furrowing machine. See MILL-STONE DRESSER.

Fa'cing Tool. See CORUNDUM TOOL; MILL-STONE DRESSER.

Fac-sim'i-le Print'ing Pro'cess. A term including the various systems of printing from a pad — usually of glycerine and gelatine — upon which the original writing in aniline ink has been transferred. See COPYGRAPH; COPYING PENCIL; HECTOGRAPH; and other titles there cited.

Fac-sim'i-le Tel'e-graph. One reproducing autograph messages.

Sawyer's autographic telegraph; also called *copying telegraph, pantelegraph, pantographic telegraph*, was described and illustrated in "*Telegrapher*," 1876; reproduced in "*Scientific American Sup.*," *302. See also "*Iron Age*," xviii., July 20, p. 3.

It operates by placing the thin plate containing the transferred message upon a cylinder at the transmitting end and a sheet of chemically prepared paper around a similar cylinder at the receiving end. As the cylinders are moved along by threads, the synchronous styles are carried around the cylinders and make the synchronous contacts as the transmitting style crosses the lines of writing. See AUTOGRAPHIC TELEGRAPH, "*Mech. Dict.*," *et supra*. See also ELECTRIC WRITING APPARATUS, *supra*, and PANTELEGRAPH, *infra*.

D'Arlincourt . . "*Jour. Soc. Telegr. Eng'rs.*," viii. 15.

Fa'ger-sta Steel. Steel made by the partial decarbonization of crude cast iron containing a considerable portion of manganese, by running the molten iron direct from the blast furnace into a Bessemer converter, where the carbon and manganese are partially removed by being burned out by the oxygen of the air used in the Bessemer process. This leaves in the metal the required amount of carbon and manganese to render it suitable for use. The usual Bessemer practice is first the removal of all the carbon and afterward to recarbonize with spiegeleisen, which is a compound of iron, carbon, and manganese.

"*Iron Age*" . . . . . xix., Feb. 1, p. 15.

Fag'got-ed Ax'le. One made of a pile of bars or rods tilted.

Faïence (pr. *fa-iān-s*). (*Ceramics.*) Enameled pottery. There are two species of faïence: the common faïence (*faïence commune*) which is a soft paste, and the fine faïence (*faïence fine*) which has a hard paste.

1. COMMON FAÏENCE is supposed to have originated in Persia, having been brought thence by the Saracens and introduced into Africa and Spain.

The stanniferous glaze which distinguishes faïence (*poterie émaillées*) from the ordinary pottery with plombiferous glaze (*poterie tendre vernissées*) was known to the Egyptians and to the Mesopotamian nations; but the art of enameling ceramic ware and tiles seems to have been again invented by successive persons.

The stanniferous enamel ware of the Saracens of the 12th century is very famous, being in extremely brilliant colors. The tiles known as Azulejos, and the Hispano-Moresque plaques and vases are also celebrated. The Saracenic pottery of the island of Majorca gave a name to the ware *majolica*. The *mezza majolica* of the 15th and 16th centuries had a leaden glaze. See MEZZA MAJOLICA.

The name *faïence* comes from Faënza, in Italy, a town celebrated for its wares, and the most famous potter on the peninsula is Luca della Robbia, of Florence, who flourished about the middle of the 15th century. He rediscovered the stanniferous enamel which soon largely superseded the previously used lead-glaze, which still, however, held its place for common ware, as it does to this day; the third order in the first class of Brogniart's classification. See POTTERY.

French *faïence* took its rise with the admirable Bernard Palissy, of Saintes, about 1535. His work had raised decorations, principally of aquatic subjects, such as fish, lizards, shells, and water plants. He died in the Bastile for his faith.

Common faïence has a soft body (*pâte tendre*), and a tin glaze, colored with various metallic oxides, and is twice fired. The body is composed of plastic clay, argillaceous marl, and sand. The clays are washed.

The following proportions are those of M. Bastenaire d' Audenard: —

	White Faïence.	Brown Faïence.
Silex	0.35	0.38
Ferruginous clay	0.58	0.57
Carbonate of lime	0.07	0.05
	1.00	1.00

The fashioning is done by molding or on the wheel, according to the character of the object. The baking of the green ware is done in a kiln at a temperature from a cherry-red to a black-red, and the subsequent firing after enameling at a somewhat higher temperature. The first firing is frequently done in the same kiln at a point more remote from the ingress of the flame.

The ware in the kiln is inclosed in some way; the modes differ. The style known in France as *l'enfournement en échappade*, consists in building up within the kiln a series of stories with refractory flat tiles and perpendicular supports, the ware being thus in cells, where it rests on the tiles directly, or on the points or edges of little prisms, or tripods (*colifichés*) of refractory clay. See SEGGAR.

See Figs. 3882, 3926, 3927, "*Mech. Dict.*" Also, Figs. 2169, 2180, *Laboulaye's* "*Dictionnaire*," ed. of 1877, tome iii., caption "*Poterie.*" For the system of inclosure in the kiln, see SEGGAR, p. 2089, "*Mech. Dict.*"

Another system is called *l'enfournement en cazette à pernettes*, and consists of a seggar in which the dishes or plates are supported by shifting ledge pieces which fit into grooves around the inside of the *cazette*, or fire-clay box. See SEGGAR.

The enamel for brown faïence is composed of: —

Minium	0.52 to 0.53
Peroxide of manganese	0.07 to 0.05
Common brick, pulverized	0.41 to 0.42
	1.00 1.00

The enamel for white faïence is of two kinds, differing principally in the proportion of tin in the metallic oxides which form an ingredient in the frit.

	Hard Enamel.	Soft Enamel.
Oxide of lead } Oxide of tin }	No. 1. { 0.77 / 0.23	No. 2 { 0.82 / 0.18
	1.00	1.00
Take of: No. 1	0.45	
No. 2	–	0.45
Minium	0.02	
Washed quartz sand	0.45	0.45
Marine salt	0.05	0.07
Soda of Alicante	0.03	0.03
	1.00	1.00

Color is given by Naples yellow, lazuli, manganese, or copper scales.

The ingredients are brought to an impalpable powder and then to a fine creamy condition in which the slip is aspersed over the object, or the latter is dipped into it.

Common faïence is much employed for wall and floor tiles, stoves, chimney plaques, etc., for which purpose any tendency to crack with the heat may be avoided by giving more fusibility to the paste by the addition of lime or alkali, but the addition of lime in any great quantity makes them apt to split with sudden variations of temperature.

2. FINE FAÏENCE, otherwise known as English *faïence*, or *English china*, is a ware of an entirely different description from common faïence; it is an English discovery, and the best quality is still made there. It is the invention of William Wedgewood, born at Burslem, in Staffordshire, in 1730.

Fine faïence is characterized by an opaque white paste, fine dense texture, and sonorous quality. It is essentially composed of a washed plastic clay, calcined flint, or finely ground quartz.

The glaze is a fritted compound of silex, soda, oxide of lead, with the addition sometimes of boracic acid.

There are three principal compositions, the names of which signify the use of notable quantities of certain ingredients in the respective pastes.

a. Calcareous or pipe-clay faïence. (Schumann.)

Pipe-clay	0.854
Silex	0.130
Chalk	0.016
	1.000

b. Flint faïence. (Oppenheim and Bastenaire.)

Pipe-clay of Montereau or Dreux	0.87
Silex	0.13
	1.00

Or: (Oppenheim and St. Amans.)

English pipe-clay	0.87
Silex	0.13
	1.00

c. Feldspathic faïence. (St. Amans.)

English pipe-clay	0.62
Kaolin	0.16
Silex	0.19
Feldspar	0.03
	1.00

Or: for "Cream color." (St. Amans.)

English pipe-clay	0.82
Silex	0.16
Feldspar	0.02
	1.00

Or: (Aiken.)

English pipe-clay	0.64
Kaolin	0.16
Silex	0·16
Feldspar	0.04
	1.00

Chalk is present, however, in all the pastes, as it is an incident to the clay and the flint.

The materials are washed, ground extremely fine, sifted, made into a slip which is strained, the pulp condensed by heat, and laid in cellars to ripen; after the manner of the Chinese, who use the clay prepared by their fathers, and prepare a new batch for the coming generation.

The paste is fine, plastic, and easily worked, and the pieces are made on the wheel with templets, gage slips, etc.; but many parts, such as handles, are made in molds and attached. Objects not symmetrical are either molded, or, as in convoluted work, thrown and then pressed to form.

The green ware is baked in the faïence kiln, and the biscuit is treated with the glaze slip either by immersion or sprinkling. The following are some recipes for the glazes of the respective wares cited above as *a*, *b*, *c*.

a. Glaze for pipe-clay faïence. (Schumann.)

Calcined feldspar	0.07
Sand	0.31
Minium	0.30
Litharge	0.27
Borax	0.03
Flint glass	0.02
	1.00

Or: (Bastenaire-d'Audenard.)

Quartzose sand	0.36
Minium	0.45
Carbonate of soda	0.17
Niter	0.02
Cobalt blue	0.00001
	1.00

b. Glaze for flint faïence.

	(Aiken.)	(Bastenaire.)
Feldspathic sand	0.40	0.42
Minium	0.23	0.26
Borax	0 23	0.21
Carbonate of soda	0.14	0.11
Cobalt blue	0.00001	0 00001.
	1.00	1.00

c. Glaze for feldspathic faïence. "Cream color." (Aiken.)

Flinty kaolin	0.25
Silex	0.13
Oxide of lead	0.52
Flint glass	0.10
	1.00

For printed faïence. (Shaw.)

Flinty kaolin	0.28
Silex	0.16
Carbonate of lime	0 04
Oxide of lead	0.30
Boracic acid	0.06
Carbonate of soda	0.16
	1.00

The small quantity of cobalt blue in some of the above glazes is merely to correct the yellow color.

The degree of heat in the final firing of the three classes of fine faïence above noted are respectively: —

	Pyrometric.
a. The pipe-clay biscuit and glazed ware	25° to 30°
b. The flinty biscuit	60°
The flinty ware	12°
c. The feldspathic biscuit	100°
The feldspathic ware	20° to 30°

The setting of the green ware or the glazed article in the kiln is by the same means as described under common faïence (2). See SEGGAR.

The faïence kiln of Staffordshire, Fig. 3926, p. 1779, "*Mech. Dict.*," is inclosed in a large dome, which serves to conduct

upward the smoke and flame issuing at the openings of the kiln proper. The furnaces are *à alandier*, so called, probably, from the way the fuel is supported on the grate. The furnaces are placed around the base of the kiln, and the draft is downward through a furnace hole into the fire, and thence by ducts below the floor and chimney to the kiln chamber. See Fig. 36, p. 20, *supra*.

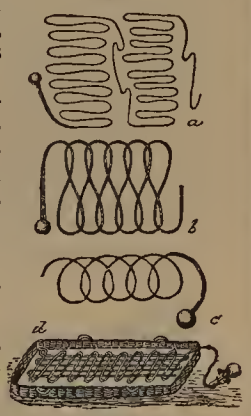
Faïence d'Oiron. (*Ceramics.*) Also known as *Henri Deux ware*. Attributed to a private pottery establishment, the atelier of Hélène de Hangest-Genlis, widow of Arthur Gouffier, and afterwards carried on by her son. Evidently a labor of love and art devotion.

Biscuit of fine clay is graven and the lines filled in with colored clays, the object glazed and fired. It is very rare. See HENRI-DEUX WARE.

Faïence Stan'ni-fere. (*Ceramics.*) Ware with glaze of oxide of tin.

Fake. A coil or disposition of rope in zig-zag, so as to run free when let go, or when a shot attached to one end of the line is fired, as in life-saving apparatus for stranded vessels.

Fig. 1000.



a. French faking.
b. Whale faking.
c. Chain faking.
d. Fake basket.

Fak'ing Box. (*Life-saving Apparatus.*) A box to contain the lines for shot firing to communicate with stranded vessels. A *fake* is a coil of rope; it is usually a helix, and a number of such built one upon another form a tier. In the faking of ropes, however, in the life-saving apparatus the fakes assume another form to enable the rope to pay out with the least impediment, so as to allow good range of the projectile without excessive charge and also avoid breakage of the shot line. "*Ordnance Report*," 1878, Appendix P, p. 200 *et seq*. Also, p. 260.

Fall'er. (*Add.*) 2. A vertical stamp in a fulling, milling, or stamping machine; usually lifted by cams and allowed to drop vertically and endwise. See STAMPING MILL. See also BEETLING MACHINE, *supra*.

Faller motion (spinning), see page 824, "*Mech. Dict.*"

Faller motion (mule) . . * "*Engineering*," xxx. 511, Figs. 13 to 17.

Fall'er Ma-chine. A machine with vertical stamps or fallers, used in milling goods.

False Joint Ap'pa-ra'tus. (*Surgical.*) Apparatus for ununited fractures.

Femur, *Smith's*	Figs. 170, 180.
Humerus	Figs. 51, 172.
Tibia	Figs. 80, 171.
Forearm	Fig. 173.

Tiemann's "*Armamentarium Chirurgicum*," Part IV.

Fan. A form of blower or ventilator.

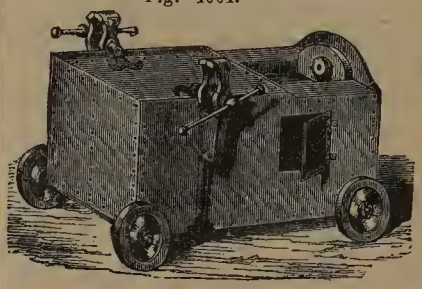
See the following references: —

Automatic, *Meyer*	* "*Sc. Am.*," xxxix. 38.
Blower, "Eclipse," *Landis*	* "*Iron Age*," xix., May 17, p. 3.
Sturtevant	* "*Iron Age*," xxv., Feb. 12, p. 1.
Exhibition (Liverpool)	"*Sc. Am. Sup.*," 1559.
Guibal, *Sacre Madame Colliery*, Fr.	"*Engineer*," xlvi. 368.
Japanese, mode of making	"*Sc. Am.*," xxxvii. 138.
Mill and elevator, Engl.	* "*Sc. Am. Sup.*," 2476.
Foot bellows	* "*Sc. Am. Sup.*," 1382.

Fan'cy Broad Loom. An efficient loom for weaving fancy goods, worsted coatings, fancy cassimeres, etc. It is made up to 92″ wide, 27 harnesses, and 4 × 4 shuttle-boxes. — *Crompton*.

Fan Forge. A transportable form of forge and fan is shown in Fig. 1001. It has tool-chest, two vises, and weighs 800 pounds. See BLOWER; FORGE; BELLOWS, etc.

Fig. 1001.



Fan Forge.

Fig. 1002.

Fan Jet.

Fan Jet. A form of nozzle for watering-pots and engines having a fan or spoon shaped lip which deflects the stream of water into a wide and thin expanding film.

Far'ad. (*Electricity.*) The *capacity* of a condenser which holds one *weber* at a potential of one *volt*. — *Gordon*.

Far-a-da'ic Cur'rent. (*Electricity.*) An induced current, as contrasted with a voltaic or direct constant current.

Far-a-da'ic Gen'e-ra'tor. A generator of electricity named by its inventor after Prof. Faraday.

The armature below revolves between the iron blocks on which the electro-magnets stand. It consists of a cylinder of wood which is wound around with iron wire (see DYNAMO-ELECTRIC MACHINE, Fig. 900, Plate XII.), like a spool. Around the whole spool are numerous loops of insulated copper wire running lengthwise of the armature. The ends of these loops are taken to the cylindrical commutator which is on the armature shaft, and from this brushes made of copper wire take the current from the machine to line.

Edison . . . * "*Scientific American*," xli. 239, 305.

Fare In'di-ca'tor. 1. A device for counting and registering fares. The wicket-gate, ticket-punch, conductor's passenger register, etc., are familiar instances.

2. A device for indicating distance traveled. See ODOMETER, p. 1544, "*Mech. Dict.*"

See FARE PUNCH; TICKET PUNCH.

Fare Reg'is-ter. A device to keep a record of the number of passengers carried in a public vehicle. The conductor's ticket-punch is one form.

Fig. 1003.

"*Monitor*" *Fare Register.*

The register, shown in Fig. 1003, is a form in which the partial rotation of a rod rings a bell and advances the hand on the dial one figure.

Fare register, Johnson	* "*Scientific American Sup.*," 3.
Sketch of various devices	"*Scientific Amer.*," xxxvii. 144.

Fare Wick'et. 1. A gate at which the passers-by are counted and registered, as at toll-bridges, exhibition grounds, etc. *A turn-stile.*

The turn-stiles used at the Centennial grounds, Philadelphia, 1876, are shown at pp. 576, 577, * vol. i., "*Report of the U. S. International Exhibition, 1876.*"

Fig. 1004.

Aveling & Porter's Farm Locomotive.

2. An opening in the door of a street-car for purchasing tickets of the driver, or for passing of fares to the conductor.

Fa-ri'na Boil'er. A saucepan with double chamber, the inner portion being in a bath of water. A double boiler.

Farm Lo'co-mo'tive. A traction engine, with adaptations to the operations of plowing, threshing, etc. See Fig. 1004.

See TRACTION ENGINE; ROAD ROLLER; PORTABLE ENGINE; STEAM PLOW, etc., "*Mech. Dict.*," *et infra.*

Aveling & Porter, Br. . . . . * "*Sc. Am.*," xxxvii. 162.
Farm machinery, on, *Knight* . . * "*Sc. Am.*," xxxix. 244.
Steam culture machines, *Knight*, * "*Paris Exposition Reports*," v., pp. 53-89.

Farm Mill. A mill for coarse grinding feed for stock. See GRAIN MILL, and various other titles, *passim.*

Fas-cine'. (*Hydraulic Engineering.*) A bundle of brush, bound into a cylindrical bundle, and secured with withes. Used in fortifications; in revetments for river-banks; in making mats for dams, jetties, etc. The fascine for mat-making is about 10″ in diameter, 12′ long, and bound with 3 withes. Six of such fascines are secured by poles to form a mat. See MAT.

For fascine making, see "*Report of Chief of Engineers of U. S. Army*," 1876, vol. ii., Part II., p. 404, and Fig. 2.
River-bank protection.
Chaplin . . . . . * *Van Nostrand's Mag.*," xix. 129.

Fast and Loose Pul'leys. The loose pulley has a smaller diameter than the fast pulley, in order that the belt may run slack when shifted to the loose pulley. — *Crafts & Filbert.*

Shinn, Philadelphia, Cooper's "*Belting*," 168.

Fau'cet. See "*Mech. Dict.*," * p. 827, and following references: —

Lempert . . . . . * "*Sc. American*," xxxvii. 351.
And vent, *Talley* . . . . * "*Sc. American*," xxxiv. 198.
Bushing, *Mantey* . . . . * "*Sc. American*," xxxiv. 38.
Hose attachment, *Trembley* * "*Scientific Amer.*," xxxv. 182.

Faure Bat'te-ry. (*Electricity.*) One in which the carbon is made in form of a cell filled with nitric acid and closed with a stopper; the pressure due to the evolution of the fumes in the vessel forces the acid through the walls of the cell, which thus performs the double function of a porous pot and a negative pole.

Niaudet. American translation . . . . . 174.
See also SECONDARY BATTERY.

Feath'er, Ar'ti-fi'cial. Artificial ostrich feathers are made in New York of celluloid, rattan, and silk, and are an excellent imitation of the original. Patented machines make the silk, the flue, the quill, and combine the flue and silk. The quill-making machine takes an ordinary piece of rattan or celluloid and produces the quill in 15 seconds; the material is drawn between two grooved rolls. In the manufacture of the flues, the silk is stretched between two machines 75 feet apart, which wind, twist, cut, and spin it into a flue.

Feath'er Plush. A French fabric in which the down of feathers is mixed with wool to form a warp to be interwoven with similar weft or one of wool alone.

"*Textile Manufacturer*" . "*Scientific American*," xlii. 232

Feed Boil'er. See AGRICULTURAL BOILER, *supra.*

Feed Crush'er. A mill for flattening grain to render it more easily masticated. A substitute for grinding. The *aplatisseur* of the French. See GRAIN CRUSHER.

Fig. 1005.

Feed Crusher.

Feed Cut'ter. A straw or chaff cutter.

Straw, *Silver & Deming.*
* "*Iron Age*," xix., Jan. 4, p. 5.
Fodder, *Dick.*
* "*Sc. Amer.*," xxxvii. 115.
* "*Mining & Sc. Press*," xxxv. 225.

See CHAFF CUTTER, ENSILAGE CUTTER, STRAW CUTTER, etc.

Feed Door. A furnace door for entry of coal. For automatic feed, see FURNACE DOOR, etc.

Feed'er. 1. A portion of an apparatus at which the material enters to be treated.

In many machines the feeder is merely a hopper

such as in various mills. In other cases the feeder is a definite portion of the machinery which conducts the material in regulated quantities. See Bolt Feeder; Gin, Cotton.

2. (*Mining.*) A small vein adjoining a larger one.

Feed'ing Tube. (*Surgical.*) These have various applications: for use in cases of lock-jaw, mania, choking paretics, paralysis of the throat, fractured jaw.

The instruments are introduced by the mouth, nose, or anus.

The mouth instruments are gags, spoons, and tubes.

The nasal operation may be by a simple funnel, a tube in the pharynx, a tube directly into the stomach. The latter introduced by Dr. Tuke. A soft rubber Nelaton catheter is now used.

The rectal administration is by enema.

Feed Mill. See Grinding Mill.

Feed Pump. A boiler supply pump. It assumes many forms. See list under Pump; Steam Engines and Apparatus, "*Mech. Dict.*" See the following references: —

Clegg . . . . . * "*Scientific American*," xl. 358.
Garrett, Br. . . . . * "*Engineer*," xlviii. 430.
" Eclipse," *Schultz* . . * "*Iron Age*," xxi., May 16, p. 1.
" Economic," *Davis* . . * "*Iron Age*," xxii., Dec. 12, p. 11.
* "*Scientific American*," xli. 150.

Feed Reg'u-la'tor. A device for graduating the feed to the necessity of the object, as of fuel to a furnace, water to a boiler, material to a machine. See Feed Water Regulator.

Feed Wa'ter Clean'er. See Feed Water Heater.

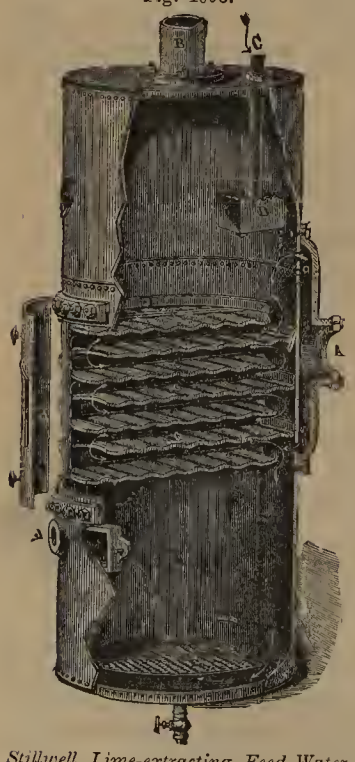
Feed Wa'ter Heat'er. An apparatus to use escaping steam or flue heat in raising the temperature of the water destined to feed the boiler.

These apparatus are of many forms, but of two general classes: —

1. Those in which the steam comes in direct contact with the feed water, as in the common *open heater*.

2. Those in which the feed water circulates through pipes which course through a chamber heated by the exhaust steam, or through a flue heated by the volatile products of combustion.

Fig. 1006.



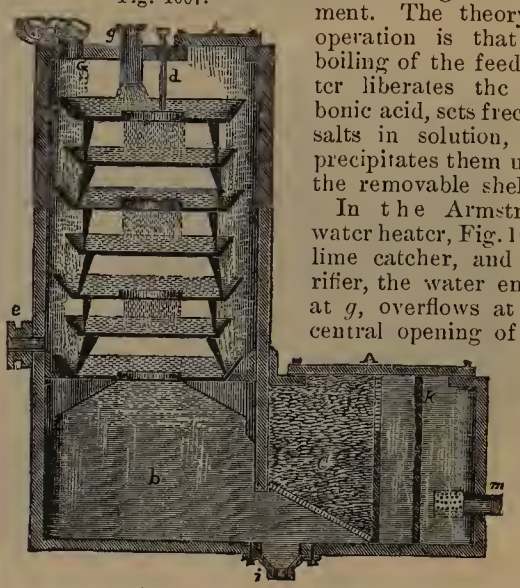
Stillwell Lime-extracting Feed Water Heater.

1. The feed water and exhaust steam mingled.

The Stillwell combined lime-extracting heater and feed-water filter is shown in Fig. 1006.

Steam enters the heater at *A*, is divided into two currents, upward and downward, and escapes at *B*. Cold water enters at *C*, pours over the edge of the over-flow cup *D* upon the corrugated depositing shelves, and then passes through chamber *E*, which is filled with a filtering material, and issues at a side opening. The bottom cock is for drawing off sediment. The theory of operation is that the boiling of the feed water liberates the carbonic acid, sets free the salts in solution, and precipitates them upon the removable shelves.

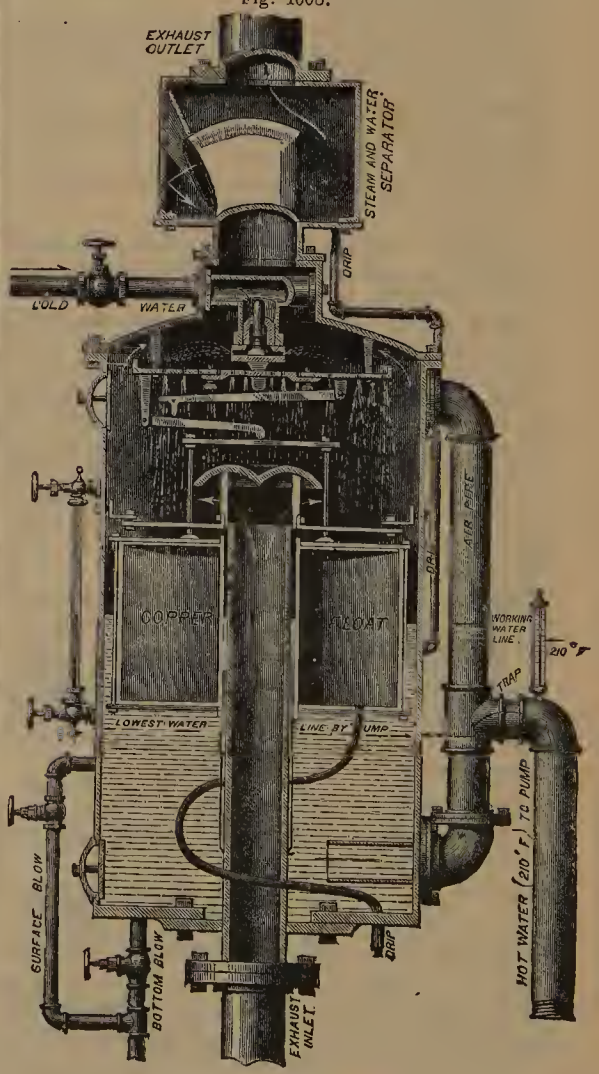
Fig. 1007.



Armstrong's Feed Water Heater.

In the Armstrong water heater, Fig. 1007, lime catcher, and purifier, the water enters at *g*, overflows at the central opening of the pan, thence into the second pan, over the margin

Fig. 1008.



Green Feed Water Heater.

of which it drips, and so on through the series of six pans, eventually reaching the settling chamber *b*. The water then passes upwardly through a filter, and then through an oil absorbent, *k*, made of burlaps. *m* is the outlet hot-water pipe, *e* inlet steam pipe, and *G* outlet; *A*, movable caps, to allow examination and cleaning; *i*, mud valve.

In the Jasper apparatus, instead of catching the lime and other impurities on shelves or in pans, these matters are detained in the mass of charcoal in the filters.

In the Green feed water heater, Fig. 1008, the water entering by the cold-water pump passes through a valve-way, the position of the valve being regulated by a float below operating through levers, its own position being determined by the water level which corresponds to that in the boiler. The exhaust steam is admitted below, and parts with its heat to the water which trickles in rain through the perforations in the plate beneath the valve. The surplus steam then passes to the separating box above.

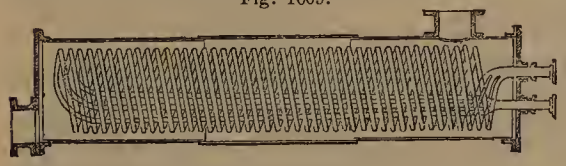
The Waters heater operates also by bringing the spray of exhaust steam in contact with a shower of water in a chamber.

The feed water heater of MM. Legris & Choisy, *Laboulaye's* "*Dictionnaire*," iv., Fig. 3453, article "Chaleur Perdue," ed. 1877, is also founded upon the principle of introducing the water of alimentation in a fine spray in a pipe traversed by the exhaust steam of the engine.

2. The other class of feed water heaters consists of apparatus in which the heat of the exhaust steam is transferred by conduction through metallic walls to the feed water.

This is an old form of condenser; also long common on

Fig. 1009.



Feed Water Heater.

the Western rivers for heating feed water for boilers of non-condensing engines.

In Wetherill's, Fig. 1009, the iron exhaust steam cylinder has bonnets at the ends, and the feed water is heated by passing it through numerous coils of copper pipe 1″ in diameter. It is used directly in non-condensing engines, and in condensing engines occupies a position between the cylinder and the condenser.

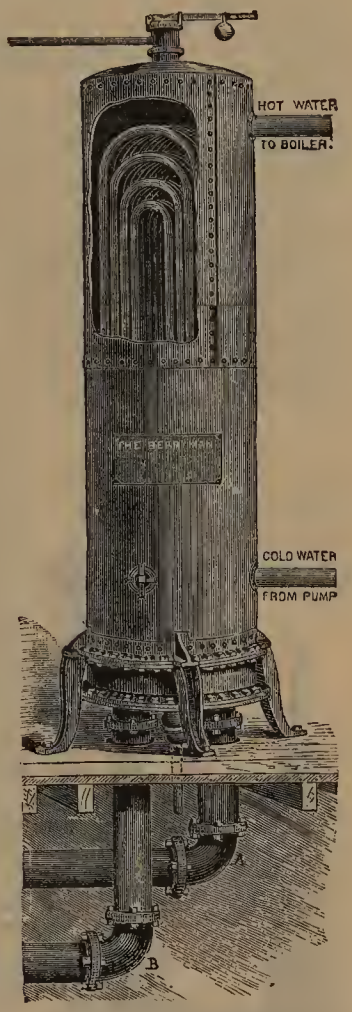
The Hawksley & Wilde (Br.) apparatus is similar in principle.

In Atkinson's apparatus (Br.) the steam passes by a circuitous route, ascending and descending in vertical pipes surrounded by water in a cylindrical chamber.

The Berryman heater is also of this class. The apparatus is placed between the engine and condenser, *B* being the exhaust steam-pipe from the engine, and *A* the steam-pipe to the condenser. Cold water from the pump enters the lower part of the cylinder surrounding the pipes, and departs at the upper end to the boiler. The number of pipes is such as to exceed by 20 per cent. the area of the exhaust steam-pipe *B*.

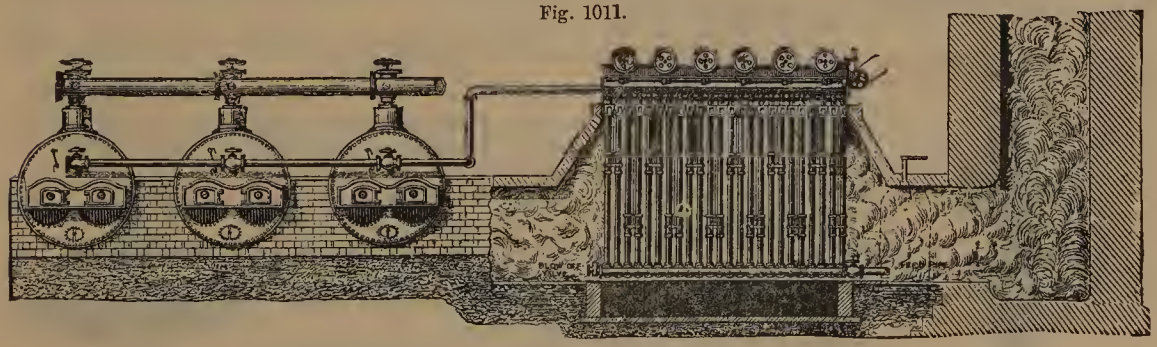
In another form of feed water heater the system of coils containing feed water is placed in the chimney. Such are some of the arrangements where the departing heat of a blast furnace is caused to heat the boiler driving the blast-engine.

Fig. 1010.



Berryman Feed Water Heater.

Fig. 1011.



Green's Fuel Economizer.

Of this class are the Twibill, Babcock & Wilcox, and Green fuel economizers; the last mentioned of which is shown in Fig. 1011. A number of upright water-pipes are placed in the main flue, beyond the boilers, and have scrapers or cleaners which move up and down the tubes to prevent the deposit of soot, which acts as a non-conductor. See Fuel Economizer; Fire Box.

Heater, *Atkinson*, Br. . * "*Engineer*," xlvi. 57.
* "*Engineering*," xxv. 436.
* "*Scientific American Sup.*," 2239.
Filter, *Babcock & Wilcox* * "*Iron Age*," xxiii., May 1, p. 9.
Heater and purifier.
Baragwanath & Pim * "*Am. Manufacturer*," Oct. 3, 1879, p. 12.
Heater, *Berryman* . . * "*Iron Age*," xxi., Jan. 31, p. 1.
* "*Engineering*," xxix., Feb. 6, p.

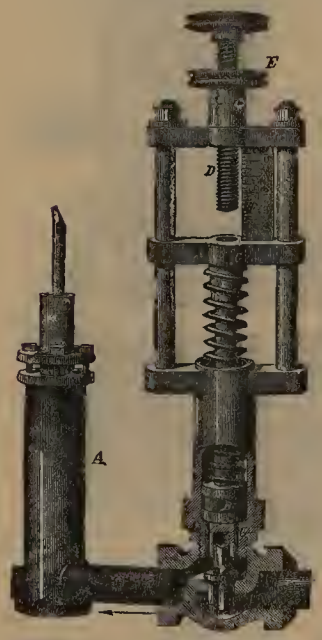
. * "*Scientific Amer.*," xxxviii. 467.
* "*Manufact. & Builder*," xi. 57.
Carvalho . . . . . * "*Scientific Amer.*," xxxviii. 118.
* "*Scientific American Sup.*," 1777.
Davies & Dawson, Br. * "*Engineer*," xliv. 454.
Green . . . . . * "*Scientific American*," xxxv. 358.
Hayes . . . . . * "*Scientific American*," xxxiv. 242.
Hawksley & Wilde, Br. * "*Engineering*," June 11, 1880.
Lime catcher, locomotives, Ill. Centr. Ry. * "*Engineer*," xlviii. 466.
* "*R. R. Gazette*," xxiii. 279.
Heater and purifier.
Lovegrove . . . . * "*Scientific Amer.*," xxxviii. 319.
Heater, *Martin* . . * "*Scientific American Sup.*," 2519.
Locomotives, *Mazza*, It. * "*Engineering*," xxvii. 24.
Northcott, Br. . . . * "*Engineering*," xxi. 169.
* "*Scientific American Sup.*," 293.
Norton . . . . . * "*Engineering*," xxii. 103.

Norton	* "*Scientific American Sup.*," 244.
Purifier, *Paucksh*	* "*Scientific Amer.*," xxxiv. 130.
Heater, *Poole & Hunt*	* "*R. R. Gazette*," xxi. 5.
	* "*Manufact. & Builder*," x. 31.
(7 Figs.)	* "*Engineer*," xlvii. 161.
Robertson & Henderson, Br.	* "*Engineer*," xlvii. 171.
Robey	* "*Scientific American Sup.*," 4090.
Stillwell & Bierce	* "*R. R. Gazette*," viii. 543.
Heater and purifier.	
Strong	* "*Manufact. & Builder*," xii. 124.
Tretheway	* "*Iron Age*," xxv., March 18, p. 9.
Locomotives, *Waters*	* "*R. R. Gazette*," xxi. 335
Counterpoised float	* "*Mech. Dict.*," Fig. 761, p. 320.

Feed Wa'ter Pu'ri-fi'er. A filter or lime catcher to purify water for steam boilers, to prevent incrustation. Usually combined with a heater. See FEED WATER HEATER.

Feed Wa'ter Reg'u-la'tor. One which proportions the feed to the need of the boiler.

Fig. 1012.



Maxim's Feed Water Regulator.

The Maxim feed water regulator was designed for steam yachts. *A* is an ordinary feed-pump, and the regulator on the right is placed between the pump and the suction. *B* is a piston-valve, pressed down by a coil spring, the valve stem rising and falling in the bar *C*. *D* is a limiting screw, and *E* a set screw. *H* is a feed-valve, and *G* holes communicating with chamber beneath the valve *B*. When the screw *D* is close down the valve *B* is inoperative and the boiler receives water due to the full stroke of the pump. When the screw *D* is up to *O*°, the water simply passes to and fro between the regulator chamber and the pump cylinder which are of equal sizes. The screw *D* is regulated against gage *F* for any quantity between full stroke and *O*°.

In the "Peerless" feed water governor, steam for operation enters the outer chamber of the valve casing, through the upper pipe, and circulates around the valve chamber which is closed by the valves. These are cone-shaped and to their stem is suspended the hollow copper float which rises and falls with the water in the boiler, and thus regulates the valve opening. The valves are balanced and upon one spindle. (Fig. 1013.)

Fig. 1013.

"Peerless" Water Regulator.

Berryman's feed water regulator is simply a hollow sphere suspended from a steelyard balance, and is connected with the water-space by two pipes of small diameter, one of which terminates just above and the other just below the proposed water-line. When the water falls, steam enters the upper pipe and fills the globe. The weight of the unloaded vessel is insufficient to counterbalance the opposite weight, and it falls, putting on the feed as it descends. When the feed has entered in sufficient quantity to raise the water-level above the mouth of the upper tube, water ascends through that tube into the globe, taking the place of the steam as the latter condenses, and the weight of the now filled vessel causes it to descend, shutting off the supply of feed.

The F. A. Pratt boiler feeder and return steam trap (patent Oct. 31, 1876) has a sphere suspended on one end of a lever in a receiving vessel above the level of the boiler, the other end of the lever being fast to a spindle which goes through a stuffing box to the outside of the receiver and carries a counterpoised lever. A tilting lever actuated as the feeder fills and is emptied of water, actuates the steam valve.

See also, for counterpoise and float actuating a valve, Fig. 761, p. 320, "*Mech. Dict.*" See also LOW-WATER ALARMS, Fig. 3008, p. 1359, *Ibid.*

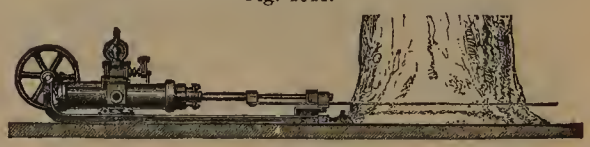
In the Nathan & Dreyfoos regulator the injector of the locomotive works freely, untrammelled by adjusting contrivances; but the actual feed to the boiler is regulated by a controlling cock, the handle in the cab, by which means a portion of the feed water passing through the delivery pipe from the injector to the boiler is diverted and turned through a pipe to the tender.

British	* "*Engineer*," xlix. 228.
Finney, Br.	* "*Engineer*," xlix. 259.
Pope, Br.	* "*Engineer*," xlv. 288.
Maxim	* "*Engineer*," xlv. 289.
	* "*Scientific Amer.*," xxxviii. 198.
Stead	* "*Manuf. & Builder*," xii. 226.

Fel'ler. A machine for felling trees. See Figs. 1935–1937, pp. 831, 832, "*Mech. Dict.*"

Fig. 1017 shows Ransome's portable horizontal engine, dogged to the tree, which it is engaged in sawing down.

Fig. 1014.



Ransome's Portable Felling Engine.

	* "*Scientific American Sup.*," 1277.
Electric feller	* "*Scientific Amer.*," xxxvi. 370.
Felling engine, *Smyth*	* "*Min. & Sc. Press*," xxxviii. 97.

Fell'ing Engine. See FELLER; FELLING SAW.

Fel'ly Bend'ing Ma-chine'. A machine for bending timber to form the rims of wheels. The heavier classes of fellies are sawn; lighter ones are bent.

See p. 832, "*Mech. Dict.*," for FELLY MACHINERY, and WOOD-BENDING MACHINE, Figs. 7311–7314, pp. 2803, 2804, *Ibid.*, for machinery not exactly for fellies, but exhibiting the principle.

Fel'ly Hold'er. A plate at a felly joint. See FELLY-JOINT BOLT.

Felly plate, *Cremer*	* "*Scientific American*," xlii. 274.

Fel'ly-joint Bolt. One adapted to clasp the joining portions of the rim of a wheel. Shown at Figure 1015. The bolt is halved into the abutting ends of the junction, and the plates embrace the exterior and interior periphery respectively of the rim.

Fig. 1015.

Felly-joint Bolt and Plate.

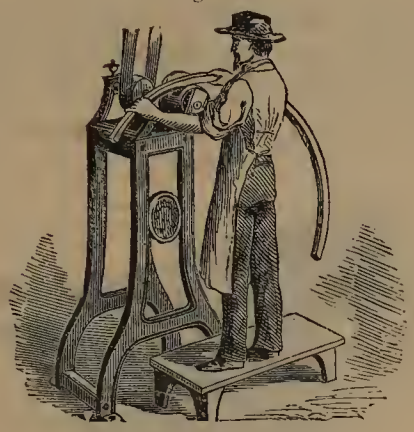
Fel'ly Ma-chine'. A machine for bending, boring, dressing, planing, rounding, sawing, etc., fellies for wheels.

See p. 802, "*Mech. Dict.*," and list of WOOD-WORKING TOOLS, p. 2814, *Ibid.* Also RIM-PLANING MACHINE, Fig. 4330, p. 1944, *Ibid.*

Fel'ly Pla'ning Ma-chine'. One for dressing the edges of rims for carriage wheels. See * FELLY DRESSER, p. 832, "*Mech. Dict.*," and * RIM-PLANING MACHINE, p. 1994, *Ibid.*

Fel'ly Round'ing Ma-chine'. A machine, Fig. 1016, for rounding the inner peripheries of rims for carriage wheels. It is a species of chamfering machine, planing off the salient edges and giving the required curve.

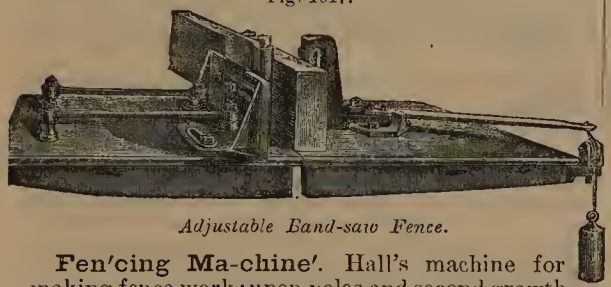
Fig. 1016.



Felly Rounding Machine.

Fence. A guide on a machine to direct the stuff to the tool, or maintain it in line while passing the tool. Fig. 1017 shows the Arbey adjustable fence and self-regulating roller for band-saw tables.

Fig. 1017.



Adjustable Band-saw Fence.

Fen'cing Ma-chine'. Hall's machine for making fence works upon poles and second growth timber, cutting the posts and rails to proper length, making the mortises in one and the tenons on the other. The posts are straightened in the line of bearings, and countersunk to parallel sides in the process of boring. The rails are sawed to uniform length, tenons and shoulders formed in their extremities fitting the bearings on the posts; all parts are interchangeable.

Flat iron fence . . . . * "*Iron Age*," xxii., Oct. 31, p. 18.
Iron fence post, *Carpenter* * "*Scientific American*," xli. 149.
Fencing machine, *Hall* . * "*Engineer*," xli. 463.
Iron fence, *Martin* . . . * "*Sc. American*," xxxix. 57.

See also machine for making combined wood and wire fence, Fig. 7280, p. 2792, "*Mech. Dict.*"

Fend'er. A screen against a carriage or car step, to keep dirt or mud from being thrown upon it by the wheels. A *fender board.*

Fender for vessels, *Hulster*, * "*Scientific American*," xl. 230.

Fen'es-tra'ted In'stru-ments. (*Surgical.*) Said of instruments such as some forceps, scoops, enucleators, etc., the grasping ends of which have openings, or loops which engage and partially embrace the object.

Fenestrated artery forceps.
Fenestrated ear scoop.
Fenestrated lens scoop, etc.
Obstetric forceps are fenestrated in the largest sense.

Fer'men-ta'tion Bung. One adapted to allow the carbonic acid gas to pass away from the cask or vat, but at the same time excluding the vital air.

Bung, beer (Fig. 27), Austria, * "*Engineer*," l. 203.
Vat, article "*Bière*" . . . * *Laboulaye's* "*Dict.*," etc., i., Fig. 229.

Fer'ro-chrome. The invention of Berthier. Chromium augments the hardness and tensile resistance of iron, but cannot take the place of carbon.

Chromized steel is manufactured in Brooklyn from Baltimore chromite as follows: The pulverized ore, mixed with charcoal dust, is fused with a suitable flux, in graphite crucibles, to obtain a white chromium alloy, corresponding to that of Berthier, and called ferro-chrome, after the analogy of ferro-manganese. — "*Engineering and Mining Journal.*"

"*Mining and Scientific Press*" . . xxxvii. 178.
"*Iron Age*" . . . . . xix., June 14, p. 9.

Fer'ro-man'ga-nese. A mineral compound of iron and manganese, of which spiegelcisen is the most prominent example.

Ferro-manganese ores contain from 5 to 40 per cent. of metallic manganese, and varying quantities of silicon.

As manufactured for steel works, in the Bessemer process, for example, ferro-manganese contains up to 95 per cent. of manganese.

The method used at Terre Noire, for the manufacture of ferro-manganese, is as follows: Metallic iron, finely divided, is well mixed with finely ground manganese ores. This mixture is moistened with a weakly ammoniacal or acid solution, and is pressed into forms. The material thus made is smelted in a blast furnace blown at a high pressure with very hot blast. The ore used seems to be a carbonate of manganese. — *M. Emil Huwaldt.*

See under the following refereuces: —

"*Iron Age*," xx., Sept. 6, p. 11; xxii., Aug. 29, p. 20; xxv., April 1, p. 1.
Imports of . . "*Iron Age*," xxii., Dec. 26, p. 20.
At Terre Noire "*Iron Age*," xxiii., May 15, p. 24.
"*Eng. and Min. Jour.*," xxi. 419; xxiv. 127.
In England . "*Engineering and Mining Journal*," xxi. 62.
In Austria . . "*Eng. and Min. Journal*," xxi. 418, 419.
Manufacture . "*Eng. and Min. Jour.*," xxiii. 217, 398, 451.
Carbon in . . "*Eng. and Mining Journal*," xxiii. 457.
At Terre Noire "*Eng. & Min. Journal*," xxiii. 109; xxv. 41.
American . . "*Eng. and Mining Journal*," xxiii. 215.
In France . . "*Eng. and Mining Journal*," xxv. 63.
"*Mining and Scientific Press*," xxxvi. 99.
Uses . . . . "*Engineering*," xxi. 253.
Manuf. in U. S. "*Engineering*," xxv. 235.
Uses . . . . "*Van Nostrand's Eng'ing Mag.*," xiv. 529.
"*Scientific American*," xxxv. 367.
In Italy . . "*Scientific American*," xxxvii. 197.
"*Scientific American Sup.*," 323, 1121.
Paper by Lockert . . . . "*Technologiste*," xxxviii. 322.

Fer'ro-phos'phide. A compound: iron associated with phosphorus.

At the Hörde Works in Germany, instead of blowing gray pig rich in silicon, it was found possible to treat white pig, if it contained a sufficient amount of phosphorus. Far from being afraid of phosphorus, about 2 per cent. of that body is required in the pig, in order to give a sufficient degree of heat to the bath. Hörde has begun to make ferro-phosphide with 20 per cent. of phosphorus, and will presently make this alloy to contain 50 per cent. phosphorus. This will be sold to mix with white pig, since the crude metal must contain phosphorus or silicon enough to carry up the bath to the heat required. At Hörde all sorts of pig, even cinder pig, with 3 per cent. phosphorus and 0.5 per cent. silicon are treated. The presence of 0.2 to 0.3 per cent. sulphur could also, it was found, be tolerated. The steel made contained under 0.1 phosphorus and no silicon. — "*Journal de Liége.*"

Fer'ro Si-li'ci-um. A metallic compound used in steel processes, the Bessemer, for example.

The use of *silicon*, iron ore, and *silicon-pig*, is mentioned in a whole series of patents by Nes, of York, Pa.,

Numbers 104,873, 108,287,
109,752, 112,068,
123,191, 145,005,

but not under the name of *ferro silicium*. See also Silicon Steel.

Fer'rule. A tubular coupling in a service pipe. Fig. 1018.

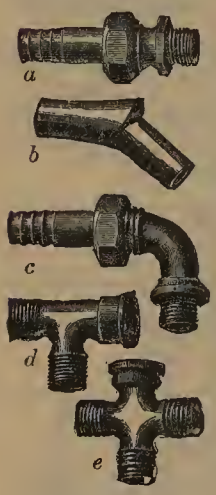
a and *c* have ground union joints tinned for lead pipe.
a, *c*, *d*, *e*, have screwed joints for iron pipe.
Fig. 1019 has a screw plug in the upper part of the stem, and this may be screwed down into the part *k*, in which position it acts as a stop valve.

Fer'ry-boat. See the following references: —

Fulton's	"*Sc. American*," xli. 132.
	* "*Transactions, Am. Soc. of Civil Engineers*," clxxiv. p. 71, *et seq.*
Thames	* "*Engineer*," xlii. 210.
Thames	* "*Engineering*," xxi. 165.
Steamers, Br.	* "*Engineering*," xxix. 252.
"Solano," San Francisco	"*Sc. American*," xli. 82.

Fer'ry Push-car. A platform car which is made very long and used for pushing or pulling other cars on or off a ferry-boat when the latter must be approached by an incline which is too steep for locomotives. The ferry cars are used to connect those cars which are to be taken on or off the boat with the locomotive, so that the latter can push or pull the cars on the boat without running on the incline. — *Forney.*

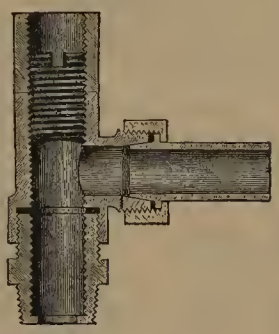
Fig. 1018.



Pipe Ferrules.

a. Straight ferrule.
b. Driving ferrule.
c. Elbow ferrule.
d. Three-way ferrule.
e. Four-way ferrule.

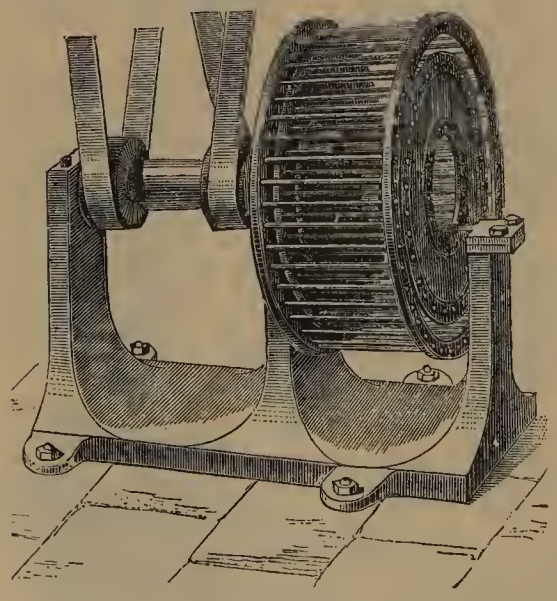
Fig. 1019.



Morris's Stop-valve Ferrule.

Fer'til-iz-er Mill. Fig. 1020 shows a mill for grinding and mixing materials for artificial fertilizers. It is constructed on the principle of the Carr disintegrator.

Fig. 1020.



Fertilizer Mill.

The double operation may be performed with advantage in the machine shown, which is formed of two cylindrical cages of iron bars, which are rotated rapidly in contrary directions. The materials thrown in fragments in at the central opening issue mixed and in a fine powder at the circumference.

See also Bone Mill.

Fer'til-iz-er Sow'er. The machines for sowing dry fertilizers resemble those for sowing grain, and in many cases are combined therewith. See Grain Drill, pp. 1002, 1003, and Wheat Drill, Fig. 7163, p. 2761, "*Mech. Dict.*"

When the fertilizer is long and damp a different mode of discharge becomes necessary. British and French fertilizer sowers are made on the principle of the machine shown in Fig. 1021. It is made by *M. Josse*, of Ormesson, France, and is particularly adapted to damp and deliquescent fertilizers, which are discharged by endless revolving chains passing through the hopper and drawing out the pulverulent material which is disengaged and dropped upon the ground.

See also Liquid-manure Cart, p. 1326, "*Mech. Dict.*"

Fig. 1021.

French Fertilizer Sower.

Fi'ber-faced Pa'per. A means of security against the restoration of the surface of check or draft-paper after it has been tampered with.

It consists in imbedding in the pulp, on one or both sides thereof, a layer of fibers, the outer ends of which are then raised in the form of a nap, confused or intermingled by rotary brushes or other suitable means, and sized to form a surface for printing or writing. — *Anderson.*

Fi'ber Test'er. A means for determining the strength of fiber by dynamometer. See Cloth Tester, *supra*; Yarn Tester, "*Mech. Dict.*"

Fischer	"*Technologiste*," xli. 533.
Irlande	"*Technologiste*," xxxvii. 28.

Methods of testing to distinguish jute, phormium tenax, flax, hemp, etc., are devised to determine purity of sample. The method of M. Vétillard requires a good microscope, and is as follows: —

The object being a piece of the fiber, is colored according to its nature by means of two solutions: one of iodine, dissolved in a solution of iodide of potassium; the other glycerine, mixed with sulphuric acid, and the process is as follows: —

a. From the tissue, perfectly washed, lixiviated, and cleared of all impurities, threads are drawn from warp and weft, and are observed separately.

b. Dip the thread in the iodie liquid, and dry it with a piece of linen, or, better still, white blotting or filtering paper.

c. Lay it on a piece of glass, such as is used for microscopic observation, and divide and spread out the fibers with the aid of the point of a needle.

d. Place another glass on the fibers, set the whole in the microscope, and then introduce a single drop of the sulphuric solution between the two pieces of glass, and observe the color which the fibers assume when the acid touches them: flax turns blue, mixed more or less with yellow; hemp, green, mixed with gray; jute and phormium, yellow; China grass, gray; flat-rib of gray-blue color. With a little practice of this method it is easy to see the difference between jute and phormium on the one hand, and flax and hemp on the other, which is of itself of great importance when there is a question of adulteration; but it is very difficult to distinguish jute from phormium and flax from hemp, as, according to the manner in which they have been prepared, they assume each other's tints, or so nearly as to deceive the eye. By means of nitric acid, in which the fibers are steeped, the distinction between flax and hemp and jute and phormium is clearly shown, the former not being affected at all, while the latter takes a fine red tint.

Testing Mixed Silk and Wool.

If a piece of tissue of mixed wool and silk is plunged in hydrochloric acid, the silk is soon dissolved, while the wool remains, so that by careful weighing before and after the

operation, the proportion of the two fibers is easily ascertained. See also SEPARATOR, 5, p. 2094, "*Mech. Dict.*"

Field Cam'e-ra. See CAMERA.

Field Gun. A transportable gun for operations in the field. See CANNON; also: —

French breech-loader, Fr.	* "*Scientific Amer. Sup.*," 2178.
Steel, Fr.	* "*Engineer*," xlv., 421.
Breech-loader, 13 dr., Br.	* "*Engineer*," l. 323.

Moffatt breech-loading field-piece, Plates I., II., III., p. 86, "*Ordnance Report*," *1876.
Sutcliffe breech-loading field-piece, *Ibid.*, *94.

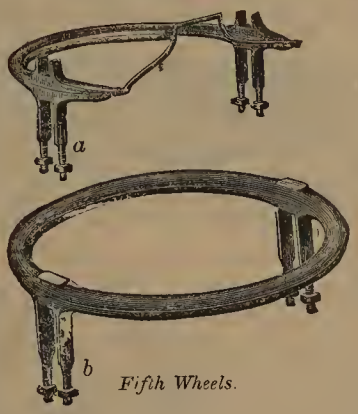
Field Rol'ler. See CLOD CRUSHER; ROLLER.

Field Tel'e-graph. A military telegraph, for use in field operations.

Wire wagon and barrow .	"*Telegraphic Journal*," viii. 121.
	"*Scientific Amer. Sup.*," 1815.

Fifth Wheel. A wheel or segment above the fore-axle on which the bed swivels in turning the carriage.

Fig 1022.



Fifth Wheels.

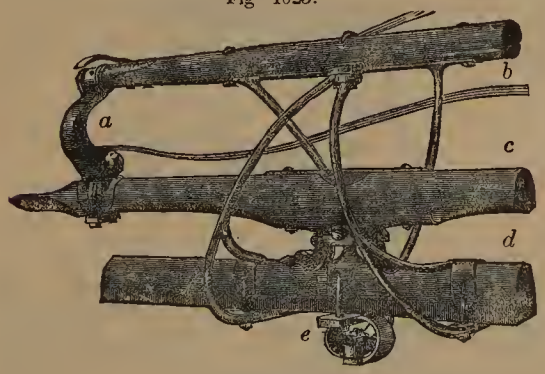
a. Larkin's anti-rattler fifth wheel.
b. Full circle fifth wheel.

Fig. 1022 shows two forms: one full-plate and one part-plate.

Fig. 1023 is the Dexter fifth wheel, which is so constructed as to steady the axle by three centers: one under the upper spring bar, one about the clip king-bolt, and one under the axle.

Fifth'-wheel True'ing Plate. A swage-plate with a number of circles of varying diameter on which fifth wheels are made true by hammering. See Fig. 1024.

Fig 1023.



Dexter Fifth Wheel.

a. Spring link.
b. Spring bar.
c. Head block.
d. Axle.
e. Lower center.

Fight'ing Lan'tern. A lantern for ships of war, having a revolving shade to instantaneously screen the light, if required. That shown in Fig. 1025 is the British Admiralty pattern, made to burn candles.

Fig'ure-of-8 Knot. (*Nautical.*) A form of knot. See 7, Fig. 2777, p. 1240, "*Mech. Dict.*"

Fi'lar Sus-pen'sion. (*Electricity.*) Said of a magnetic needle, which is suspended by a filament of silk, as distinguished from one poised on the point of a stud.

Bi-filar suspension is when the needle is suspended by two slightly separated extremely delicate filaments of raw silk, by which the needle is caused to more promptly resume its normal position; *i. e.*, is given a normal tendency to zero.

File. Files have been made of separate pieces of steel clamped together. — *English "Ironmonger,"* 1880.

Mentioned also by Kirkwood at a meeting of the Royal Scot. Soc. of Arts. Shown, however, in several American patents.

Harston . . .	Jan. 19, 1858.
Cubberley . . .	June 2, 1868.
Clark	July 5, 1870.

The Hapstontall file (Patent, 1875) has an abrading surface formed by

Fig. 1024.

Fifth Wheel Trueing Plate.

Fig. 1025.

Fighting Lantern.

successive series of diagonal teeth in alternate sections and at opposite angles.

See the following references: —

Files, American	* "*Scientific Amer. Sup.*," 860.
File-cutting machine.	
Dobson & Mudge, Br. . .	* "*Engineer*," xlvi. 351.
File holder	* "*Scientific Amer. Sup.*," 161.
	* "*Eng. & Min. J.*," xxvi. 328.
File, *Hapstonstall*	* "*Scientific Am.*," xxxiv. 291.
How to use a, *Rose* . . .	"*Scientific Am.*," xxxix 53
Filing, a wrinkle in, *Rose* .	* "*Scientific Am.*," xxxix. 245.
Files *vs.* Emery wheels, etc.	"*Scientific Amer. Sup.*," 995.
Files. Paper by *Rose* . .	"*Eng & Min. J.*," xxvi 328.
Files and handles	* "*Man. & Builder*," xii. 84
Guide, *Roth*	* "*Scientific Am.*," xxxiv. 6.
Sharpening by sand-blast.	
Tilghman	* "*Man. & Builder*," x. 228.
Richardson	* "*Eng. & Min. J.*," xxvi. 149.
	* "*Sc. Am.*," xxxviii. 406.
Tilghman	* "*R. R. Gazette*," xxii. 394.

File Card. A tool for cleaning the metallic dust out of files. It is a section of card clothing, such as is used in carding-machines for wool or cotton.

File Guard. A grooved wooden holder in which a file is inserted, so that the file may be used without abrading the fingers. * "*Scientific American*," xl. 131.

File Hold'er. A helve for a file.

See FILE CARRIER, Fig. 1966, p. 841, "*Mech. Dict.*," and * "*Scientific American*," xxxix. 117.

Fil'i-form Bou'gie. (*Surgical.*) One of the most delicate (hair-like) proportions.

Fil'ing Vise. A clamp in which a saw is held while being filed. See VISE; also BAND-SAW SETTING AND FILING MACHINE.

Fil'ter. See list on p. 846, "*Mech. Dict.*"

Adolph Le Tellier's filter, made at St. Gilles, near Brussels, has a raised bottom in which are inserted a number of removable vertical tubes, with perforated walls, and with handles at the top. These tubes are surrounded with flat felt filtering rings, through which the liquid must pass before escaping through the perforations in the tubes. The supply-pipe has a compression shut-off, actuated by a float and lever.

Weiskopf, of Morchenstern, Bohemia, employs spun glass as a filtering material.

See the following: —

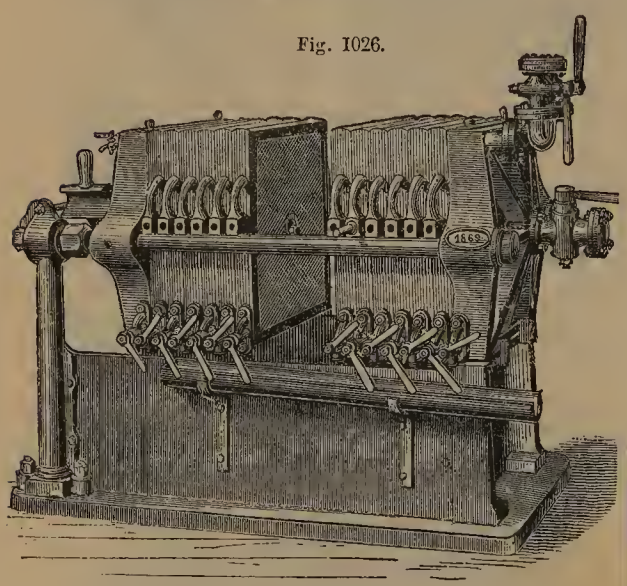
Intermittently drying, *Denton*, Br.	* "*Engineer*," xlii. 357.
Denton, Engl.	* "*Sc. Amer. Sup.*," 883.
Press	*Laboulaye's* "*Dict.*," iii., art. "*Sucre*," Figs. 36, 56.
Rapid (Laboratory), *Hindley* . .	* "*Sc. Am. Sup.*," 1786.

Rapid, *Holthof* . . . . . "*Sc. Am. Sup.*," 1363.
"*Sc. Am. Sup.*," 1671.
Filtration, on, "*Inst. Civil Eng.*,"
Br. *Higgin* . . . . . * "*Van Nostrand's Mag.*," xxii. 72.
System, *Jennings* . . . . . * "*Man. & Build.*," x. 169.
"*Sc. Am.*," xxxviii. 65.
Cloth stretcher, *Johnson* . . . * "*Engineer*," l. 265.
Floating well, *Lindsay* . . . . * "*Sc. Am.*," xlii. 20.
Water (Montreal) . . . . . "*Sc. Am. Sup.*," 472.
Rotary, *Perrett*, Br. . . . . * "*Engineer*," xiii. 101.
Universal, *Platt* . . . . . * "*Sc. Am. Sup.*," 2581.
Rotary clearing, *Pulsometer Co.* . * "*Engineer*," xlviii. 124.
Engl. . . . . * "*Sc. Am. Sup.*," 1060.
Sugar . . . . . *Laboulaye*, "*Sucre*," Fig. 50, vol. iii.
Water, *Snook* . . . . . * "*Min. & Sc. Press*," xxxvi. 321.
Filtering Apparatus . . . . . * "*Sc. Am. Sup.*," 2471.
Stock . . . . . * "*Sc. Am. Sup.*," 2689.

Fil'ter Press. (*Sugar Manufacture.*) One in which the liquid is pressed from a mass — beet-root-pulp in the present instance — and the solid portion retained by a straining device.

The Farinaux press, shown in Paris, 1878, has a series of gridiron-shaped frames, the faces of which are covered with a filtering surface of linen or jute cloth. These frames are arranged parallel to each other upon a strong support, and are brought into close contact by means of a screw-press fixed to one end of the support. The material to be filtered is forced between the frames through a passage along the side or through the center, and distributes itself over the filtering surface; the liquid portion, finding its way into

Fig. 1026.



Farinaux Filter Press.

the interior of the frame, is drawn off at the bottom by means of a stop-cock attached to each one, while the solid portion is held back between the filtering surfaces. When the press is fully charged, the pressure holding the frames together is removed, the frames separated, and the pulp allowed to fall into a recipient underneath. If necessary, the cloth is cleaned by means of a rush.

Press, Fr. *Farinaux* . . "*Dept. Agric. Sp. Rept.*," xxviii. Plate XXV.
Centrifugal . . . . . *Ibid.*, xxviii., Plate XXIX.
Beet-press, *Poizot* . . . *Ibid.*, Plate XVI.
Lebée . . . . . *Ibid.*, Plate XVII.
Dujardin . . . . *Ibid.*, Plate XX., and page 141.
Champannois . . . * p. 87, *supra*.
Manuel et Socin . . * p. 87, *supra*.
Pieron . . . . . * p. 88, *supra*.

Find'er. (*Optics.*) *a.* As applied to the telescope, a small low-power glass fitting on the side of the large one for finding an object.

b. As applied to the microscope, a means for registering the position of an object on a slide so that it can be readily found again. The *Maltwood* finder.

Fine Art Met'al-work. See under the following heads: —

Antique bronzing.
Applique.
Bidiri work.
Bronze coloring.
Champ levé.
Chasing.
Cire perdue.
Cloisonné.
Damasceening.
Damasking metals.
Electro-bronzing.
Emaille.
Enamel.
Flat chasing.
Frosting.
Incrusted work
Inlaying.
Irisation.
Japanese bronzes.
Kuft-work.
Milling.
Niëllo.
Orugo.
Parcel gilt.
Patina.
Pearl inlaying.
Repoussé.
Satining.
Snarling.
Spinning.

Fin'ger Mir'ror. A small mouth-mirror attached to a finger clasp; used by dentists.

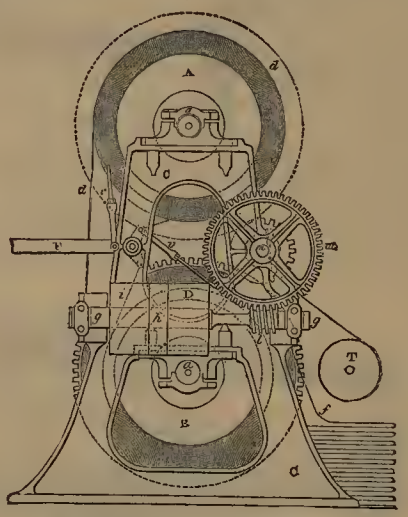
Fin'ger Steel. (*Leather.*) A steel instrument like a skewer or awl used for restoring the edge of the currier's knife while in use.

Fin'ger Tray. A small pan attached by a clasp to the finger; used by dentists for carrying amalgam or plastic filling.

Fin'ish-ing Press. A machine for pressing fabrics.

A and *B* are steam drums having toothed wheels acted upon by cam wheels on the shaft *n*, which is turned by an endless screw and toothed wheel, receiving their motion from a belt and pulley. The cam wheels turn the drums in oppo-

Fig. 1027.



Houston's Cloth Finishing Press.

site directions; one cam wheel only works at a time, the drum not acted upon by the cam wheel being carried along by the friction pulley. Thus the operator is enabled to change the motion of the drum as often as necessary. From the drum *A* to the drum *B* a long sheet or band of copper or steel extends, and alternately winds and unwinds round both drums, carrying the goods along. The fabric is unrolled from a cylinder, *T*, moved solely by the tension of the goods as they are rolled on the cylinder *B*. The copper band is heated on the cylinder *A* and catches in descending the sheet of fabric, and rolls up along with the same on the cylinder *B*. Thus the entire surface of the goods comes in contact with the heated metal, and is equally exposed to the pressure exerted by the concentric sheets of copper. The goods are not strained, but subjected to heat and pressure only, removing all folds. — *Musee de l'Industrie.*

Fire A-larm'. See the following references: —

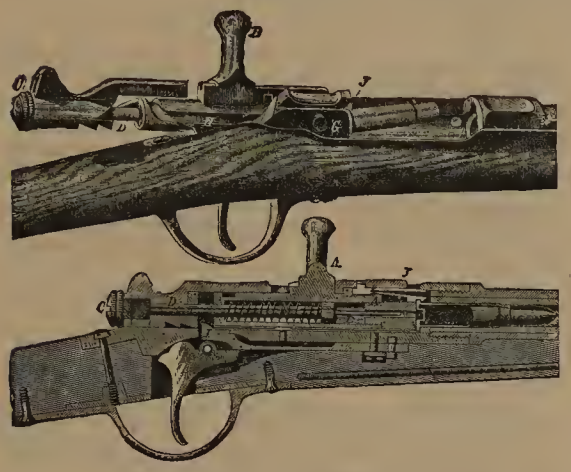
Indicator, electrical, *Bright* . * "*Teleg. Jour.*," vii. 56.
Electric, *Gaulnier* . . . . . * "*Sc. Amer.*," xxxv. 246.
And bell pull, electric, *Gaulnier*, ... * "*Sc. Amer.*," xxxvi. 4.
Gong, German . . . . . * "*Sc. Amer.*," xxxviii. 403.
And water indicator, *Gerard* . * "*Sc. Amer.*," xl. 102.
Ships holds, *Higgins* . . . . * "*Teleg. Jour*," vi. 271.
Tell-tale, Electric, *Leblanc*, Fr. * "*Engineering*," xxvi. 445.
"*Sc. Am. Sup.*," xxiv 34.
Signals, London . . . . . * "*Engineering*," xxiv. 135.
Telegraph, Spanish . . . . "*Teleg. Jour*," iv. 199.

German . . . . . * "*Sc Am.*," xxxviii. 402.
Telegraph, Prague . . . . * "*Engineering*," xxx. 225, 287.
Telegraphs, various systems * "*Engineering*," xxiii. 223, 402.

Fire Arm. Fig. 1028 shows the new service gun of Capt. Gras, adopted for the French army.

The upper figure shows the piece in the position as the cartridge is being extracted, and the lower figure as it is ready

Fig. 1028.



The Gras Rifle. The French Service Arm.

to fire. *A* is the movable breech piece operated by the lever. *C* is the dog, at the end of which is a button, to which the rod *D* of the firing pin *E* is attached *F* is the coiled spring, which throws the pin forward For loading the gun, the parts are drawn back as shown in the upper figure. The cartridge is inserted and the bolt *A* by the lever *B* is drawn forward. While this is being done, a stop, *G*, enters a cam groove, *H*, in the side of the bolt *A* so that the latter is forced to turn as it is brought forward In the lower figure it will be noticed that the notch on the dog *C* is almost in contact with the spring stop *I* governed by the trigger. By pulling on the latter, this stop is withdrawn, and the needle is thrown forward by its spring, striking and exploding the cartridge. At *J* is the extractor, the part containing which, though drawn back, does not turn with the movable breech, so that the spring hook always grasps the rim of the cartridge case from above. With this gun it is stated that 45 shots can be fired in three minutes, effective at a range of 5,120 to 5,440 feet.

Breech-loader, *MacNaughten* * "*Engineer*," l. 400.
Royal . . . . . * "*Scientific Amer.*," xl. 56.

See also MAGAZINE FIRE-ARM, *infra*.

Fire'-arms, Ord'nance, Ex-plo'sives, etc.

Action.
Air gun.
Air pistol.
Ambulance.
Ambulance cot.
Ambulance stretcher.
Anchor shot.
Anvil.
Anvil cupper.
Aperture sight.
Armored gun.
Armor plate.
Armstrong gun.
Army wagon.
Assembling.
Balloon musket.
Balloon torpedo.
Ball seater.
Ball trimmer.
Bar and bead sight.
Bar and slit sight.
Barbed shot.
Barrel.
Barrel-boring machine.
Battery gun.
Bayonet.
Bayonet manufacture.
Beach combination sight.
Bead sight.
Blasting apparatus.
Blasting compound.
Blasting gelatine.
Blow gun.
Bolt.
Bomb lance.
Brake.
Breaking-down machine.
Breech.
Breech-loading fire-arm.
Breech wrench.
Buck-horn sight.
Bullet.
Bullet machine.
Bullet-making.
Bullet-patching machine.
Bump.
Burgoyne.
Butt lathe.
California sight.
Camp cot.
Cannon.
Cannon lock.
Cannon revolver.
Cap.
Capper.
Carbine.
Cartridge.
Cartridge-block.
Cartridge-capper.
Cartridge-heading machine.
Cartridge-head tester.
Cartridge loader.
Cartridge making.
Cartridge scales.
Cartridge varnishing machine.
Case.
Casemate.
Case-trimmer
Chamber.
Charcoal-grinding machine.
Charger.
Circle.
Clamp milling machine.
Clover leaf sight.
Coiling machine.
Comb.
Conversion.
Countersink.
Covered sight.
Cross-bar.
Crusher gage.
Cube powder.
Cup anvil.
Cupping machine.
Decoy.
Deringer.
Dice.
Diorrexine.
Direct fire.
Disk anvil.
Drawing machine.
Drying house.
Drying stove.
Dualin.
Dusting machine.
Dynamite.
Éprouvette.
Explosive bullet.
Explosive gelatine.
Explosives.
Extractor.
Field gun.
Field-piece.
Fire-arm.
Fog gun.
Fore-end.
Fort.
Front sight.
Fuse.
Gas check.
Gas gun.
Gatling gun.
Gelatine, Blasting.
Glacis.
Glazing barrel.
Globe sight.
Graduating sight.
Granulated-wood powder.
Granulating machine.
Grapple shot.
Gravel powder.
Grenade.
Guard.
Gun.
Gun barrel.
Gun barrow.
Gun brush.
Gun carriage.
Gun cotton.
Gun flint.
Gunpowder.
Gunpowder machine.
Gun-stocking machine.
Gun-stock lathe.
Gunwale gun.
Gyro-pigeon.
Hammerless gun.
Hand.
Hausse.
Heel-plate
Herakline.
Hind sight.
Hoop-heating furnace.
Hoop-shrinking apparatus.
Howitzer.
Hydraulic buffer.
Hydro-pneumatic gun carriage.
Impression machine.
Incorporating mill.
Indirect pointing apparatus.
Infernal machine.
Intrenching spade.
Jacketed gun.
Jack lamp.
Jelly powder.
Jerk snare.
Lead-wire apparatus.
L. G. R.
Leaf sight.
Level.
Lever.
Life-saving rocket.
Lignose.
Limber.
Line-throwing gun.
Loading machine.
Loading plug.
Loop.
Lubricator.
Lump.
Machine gun.
Magazine.
Magazine gun.
Magazine rifle.
Maneuvering wheel.
Mantlet.
Mat.
Match.
Mitrailleuse.
Mixing machine.
Mortar.
Mortar carriage.
Mortar truck.
Mountain gun.
Mountain howitzer.
Muzzle.
Muzzle-pointing gun.
Muzzle sight.
Nail gun.
Needle gun.
Nitro-gelatine.
Nitro-glycerine.
Oblique fire.
Obturator.
Open bead sight.
Open sight.
Pack saddle.
Palstave.
Papyroxyline.
Pebble powder.
Pebble-powder machine.
Peep sight.
Pellet powder.
Pellet-powder machine.
Percussion fuse.
Pin-ball sight.
Pistol.
Pistol grip.
Pistol handle.
Pistol rifling machine.
Plain sight.
Plate.
Plunger.
Potentite.
Poudre-brutale.
Powder-dusting machine.
Powder paper.
Powder-pressing machine.
Pressure gage.
Primer.
Primer extractor.
Priming machine.
Prismatic powder.
Pyrophore.
Pyrophorus.
Pyroxyline.
Racer.
Rear sight.
Rebounding gun-lock.
Recapper.
Recoil check.
Reflecting sight.
Reinforce.
Reloading tool.
Repeating rifle.
Re-primer.
Rest.
Revolver.
Revolving cannon.
Rib.
Ring.
Rifle.
Rifle battery.
Rifle cane.
Rifling machine.
Rocket.
Safety pin.
Salpeter and sulphur grinding-mill.
Saltpeter, sulphur, and charcoal mixing-mill.
Sear.

Sebastine.
Set trigger.
Shell.
Shell reducer.
Shell truck.
Shot.
Shot-gun.
Side action.
Sight (varieties, see list.)
Skate.
Sling wagon.
Slit-bar sight.
Small arm.
Snap action.
Spar torpedo.
Spear-head.
Spirophorus.
Sporting sight.
Squib.
Stacking swivel.
Stock.
Straightening stand.
Strap
Stretcher.
Submarine gun.
Sword.
Syringe gun.
Tapering and crimping machine.
Target.
Telescopic sight.
Tent.
Throwing-stick.
Thumbing.
Time gun.
Toe.
Tonite.
Torpedo.
Torpedo boat.
Torpedo carriage.
Torpedo catcher.
Torpedo depot ship.
Torpedo launch.
Torpedo vessel.
Training gearing.
Traveling forge.
Traverse circle.
Traverse rack.
Traverse wheel.
Trowel bayonet.
Tube.
Tumbler.
Turret.
Turret gun.
Twisting rod.
Uncapping knife.
Vernier scale sight.
Vest-pocket pistol.
Vigorite.
Volley-gun.
War engine.
Whale gun.
Whaling rocket.
Whitworth gun.
Wind gage.
Wind-gage sight.

Fire Bar. See the following: —

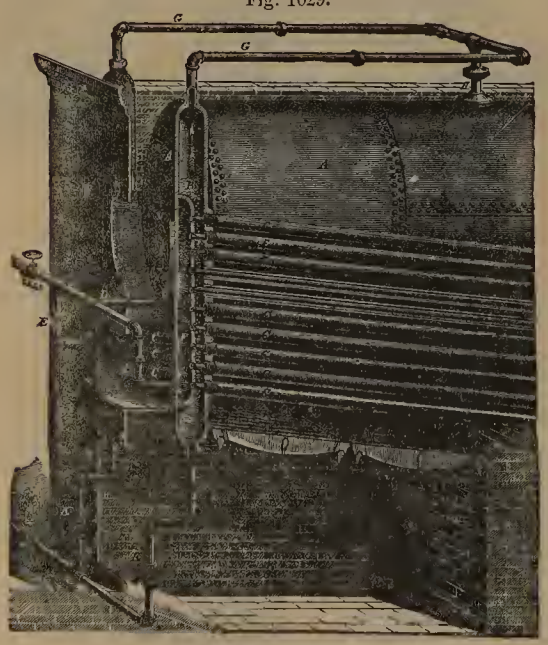
Chain, *Welch*, Br. . . * "*Engineer*," l. 72.
* "*Scientific American Sup.*," 3881.
Revolving, *Schmidt* . . "*Revue Industrielle.*"
Rocking . . . . . * "*Scientific American Sup.*," 2050.

See also GRATE; GRATE BAR, *infra.*

Fire Box. The chamber of a furnace. In the instance shown in Fig. 1029, the sides of the furnace are made up of, or rather lined with, flat congeries of pipes, which act as feed water heaters. Known as *economizers*. See FEED WATER HEATER; FUEL ECONOMIZER; HOT-BLAST APPARATUS; REGENERATOR, etc.

Fire boxes in the present instance consist of two sections, each made of ten wrought-iron tubes, *C*, 3′′ diameter and 10′ long; one end of each of these tubes is secured to a larger

Fig. 1029.



Fire-box and Economizer.

chamber *B;* the other end is closed with a cap and reaches beyond the bridge-wall. The chamber *B* is divided by partition *F*, and into this partition ten brass tubes are secured which are open on both ends and reach to near the end of the iron tubes beyond the bridge wall. When two of these sections are placed one on each side of a boiler, and the top of chamber *B* is connected with the top of the boiler by means of the pipe *G*, and a water connection is made with the lower part of the boiler and the section by the pipes *D* and *E*, then the water from the boiler will flow through the ten brass tubes to the end of the iron tubes, and when fire is applied the steam will rise through the space between the brass and iron tubes into the chamber *B* and through the pipe *G* into the boiler, producing a rapid circulation, not only in the tubes but also increasing the circulation in the boiler

See the following references: —

Locomotive, *Belpaire*, Belg. . * *Thurston's "Vienna Report,"* ii. 79.
* "*R. R. Gaz.*," xxiv. 365.
Engine, *Fox & Greig*, Br . . . * "*Engineering*," xxx. 45.
Tubular flue boilers, *Kaselowsky*, Ger. . . . . * "*Engineer*," xlii. 418.
Locomotive, *Kaselowsky*, Berlin. * "*Sc. Amer. Sup.*," 934.
Locomotive, Penn. Railway . . * "*R. R. Gaz.*," viii., 139.
Crown arch, *Rajputna State Ry.* * "*Engineer*," xlviii. 378, 414.
Locomotive, *Ten-brink* . . . * "*Engineering*," xxvii. 455.
Staying, *Wehrenfennig*, Aust. . * "*Engineer*," xlviii. 455.
Locomotive, *Wootten* . . . . * "*R. R. Gaz.*," xxiv. 495.
Wootten . . . . . * "*Engineer*," l. 282.

Fire Brick. Usually made of silica and refractory clay, with a small proportion of cementing material.

Some fire bricks are made into which clay does not enter as an ingredient.

In England quartz is ground and freed from iron by sulphuric acid. It is considered better than sand. In Wales bricks are made of ground quartz with one per cent. of lime and water sufficient. The brick is pressed in iron molds, and the lime acts as a flux to cement the quartz.

The composition of good fire bricks is indicated by three analyses: —

Carter County, Kentucky, Clay.

Silica	45 to 64
Alumina	23 to 43
Oxide of iron, a trace.	
Lime, a trace.	
Potash	0.212 to 2.093
Soda	0.283 to 0.728

Belgian Fire Clay.

Silica	64.2
Alumina	32.2
Oxide of iron	2.4
Lime	0.0
Alkalies	1.2
	100

Clays of Forges-les-Eaux and Ardennes, in France; Belgium; Stonebridge, England; Klingenberg, Germany, vary between the following proportion: —

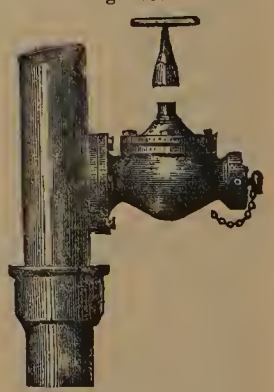
Silica	64 to 71
Alumina	22 to 38
Oxide of iron	0.2 to 4
Lime	trace to 1
Alkalies	trace to 1

Fire bricks, see on, "*Blake's Reports on Ceramics*," "*French Exposition* (1878) *Reports*," vol. iii., 215 *et seq.*

Fire bricks, *Dunnachie* on, "*Van Nostrand's Mag.*," xvi. 6.

Fire Cock. A cock attached to a stand pipe in a building, one cock to each floor, and having a hose attached capable of reaching any part of that story of the building, or the part destined to be within range of that particular stand pipe. In the illustration the apparatus has a cap to be removed and the hose coupling attached.

Fig. 1030.



Fire Cock.

Fire-damp′ A-larm′. One for automatically giving notice of presence of fire-damp in a mine.

See also FIRE-DAMP DETECTOR.

Fire-damp′ Detect′or. An instrument for detecting the pres-

ence of proto-carbide of hydrogen in a mine. Coquillon's test for quantity is considered under GRISOUMETER.

Forbes's test for presence is founded on the facts that sound travels quicker in light gases than in denser ones, and that air containing fire-damp is lighter than pure air. The instrument detects 0.5 per cent. of impurity.

The test for fire-damp by the observation of the blue fringe of the Davy safety-lamp is only practicable where the atmosphere contains at least 3 per cent. of the explosive gas. M. Galloway has shown that 0.75 per cent. is explosive in presence of fine coal-dust.

MM. Mallard and le Chatelier propose a safety-lamp in which a jet of hydrogen gas is burned instead of the ordinary oil. The flame is hot, gives but little light, and in burning the explosive gas elongates and exhibits freely the blue fringe. 0.25 per cent. is detectable by this means.

Another instrument by Prof. Forbes for detection of fire-damp consists of a resonator of variable dimensions and a tuning-fork of definite pitch. The resonator is a metallic tube, 1″ in diameter and 14″ long, in which a piston slides, so as to regulate the length of the tube. This tube is fixed to a block of wood, to which is attached a tuning-fork whose points are just above the open end of the tube. The tuning-fork is sounded and the piston is moved until the proper length is found, which is indicated by the resonator intensifying the sound of the tuning-fork. Barometric pressure produces no difference on the instrument. The temperature correction is made by reading off a thermometer of the proper dimensions instead of reading off a fixed mark on the piston. The only error is by the presence of dense carbonic acid gas, but the carbonic acid gas tends to destroy the explosive character of fire-damp, and it appears that if the presence of carbonic acid prevented the instrument from indicating fire-damp it would certainly be sufficient to prevent the explosive character of fire-damp.

See the following references : —

Coquillon, Fr. . . * "*Engineer*," xlix. 33.
* "*Scientific American Sup.*," 4060.
Forbes, Br. . . . * "*Engineering*," xxviii. 213.
"*Scientific American Sup.*," 2303.
Liveing . . . . . * "*Scientific American Sup.*," 4030.

See also GRISOUMETER; FIRE-DAMP PHOTOMETER.

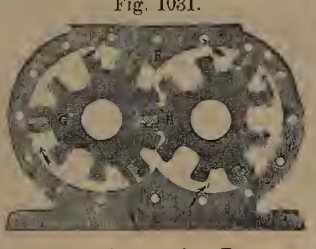
Fire-damp Me'ter. An instrument for determining the amount of proto-carbide of hydrogen in a mine. Coquillon has contrived several forms: one for use in a mine and the other for the laboratory. Both depend on the principle that hydrogen and its gaseous carbides are completely burned in presence of oxygen and a palladium wire heated to white redness. See GRISOUMETER.

Fire-damp' Pho-tom'e-ter. An apparatus by Liveing, of London, for the detection of the presence of proto-carbide of hydrogen in air. It acts upon the principle of using the electric current for causing the combustion of the fire-damp and a photometer for observation of the luminous intensity.

A platinum wire rendered incandescent by the passage of an electric current, is more brilliant in air contaminated with the fire-damp, and proportionally so by increasing the quantity of the proto-carbide. The comparison is made by the photometer of the incandescent wire in pure air and the wire in mixtures of definite proportions of air and fire-damp, and thus a scale is obtained. — "*Transactions Physical Society of London.*" "*Scientific American Supplement*," * 4030.

Fire En'gine. The Silsby fire engine, Plate XV., has a steam rotary pump, shown in section in Fig. 1031. The boiler is tubulous and vertical, and is shown in Fig. 1032. The engine and the pump are substantially similar, in the former case, however, the pressure of steam drives the three-toed pistons, and in the latter, the pistons drive the water. Steam piston and pump pistons are coupled and connected. The boiler, shown in Fig. 1032, has depending tubes and vertical flues giving a large heating surface. One of the water tubes is shown separately at the left of the boiler. Plate XV. shows the complete engine.

Fig. 1031.



Silsby Fire Engine Pump.

The La France steam fire engine also has the rotary principle.

Fig. 1032.

Vertical Fire Engine Boiler.

See the following references : —

Amoskeag Co. . . . . . * "*Polytechnic Rec.*," Mar., 1876, p. 18.
Chemical, *Babcock* . . . . . * "*Amer. Man.*," Apr. 18, 1879, p. 6.
Chemical, *Clapp* . . . . . * "*Sc. Amer.*," xxxvii. 111.
Floating, *Edwards & Symes*, Br. * "*Engineering*," xxiii. 125, 127.
English . . . . . "*Sc. Amer.*," xxxv. 255.
Engine pump, Br. . . . . "*Sc. Amer. Sup.*," 1906.
Steam, Engl. . . . . * "*Sc. Amer.*," xxxix. 246.
London . . . . . * "*Sc. Am. Sup.*," 1747.
Gould . . . . . * "*Sc. Amer. Sup.*," 419.
* "*Polytechnic Rev.*," Mar., 1876, p. 19.
* "*Engineering*," xxi. 432.
Injector hydrant, *Greathead*, Br. * "*Engineering*," xxviii. 80.
Hand, *Hull* . . . . . * "*Sc. Amer.*," xxxv. 127.
Steam, *Moorlen* . . . . . * "*Sc. Amer.*," xxxix. 319.
Steam, *Rumble*, Engl. . . . . * "*Sc. Amer. Sup.*," 2447.
Steam, *Shand & Mason*, Br. . . * "*Engineer*," xliv. 423; xlvi. 165.
Fire-engine, rotary, *Silsby* . . * "*Sc. Amer.*," xxxv. 115.
Silsby . . . . . * "*Thurston's Vienna Report*," ii. 104.

Reports of trials, "*Centennial Exhibition Reports*," vol. vi., Group XX., includes the following : —

Gould . . . . . * p. 283.
Clapp & Jones . . . . . * p. 285.
Silsby . . . . . * p. 289.
Amoskeag . . . . . * p. 292.

Fire Es-cape'. Figs. 1033, 1034, show respectively French and American forms of clutches to run on ropes when a person, suspended to either of them, is descending from the window of a burning house.

In Fig. 1033, the rope being firmly attached in the room, the person is suspended from the hook below, and the rope

Fig. 1033.

French Fire Escape.

Fig. 1034.

Rope Clutch.

being roven through the grooves, the friction opposes its rapid motion; the friction is increased by grasping the rope while descending.

In Fig. 1034, the rope runs through a fair leader groove in a hinged box; the two parts of which compress the rope in any required degree, so as to prevent too rapid descent of the person suspended therefrom by the hook *D*; *A* is the pulley-wheel, and *C* the pinch screw.

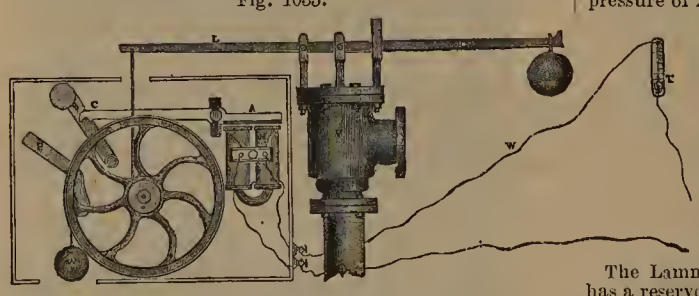
See the following:

Allen	* "*Sc. Amer.*," xxxvii. 163.
Clutch	* "*Sc. Amer.*," xxxvi. 335.
Portable, mounted, *Davis*	* "*Iron Age*," xxii., Dec. 12, p. 7.
Portable ladders, *Falk*	* "*Manufact. & Builder*," ix. 150.
Portable, *Falk*	* "*Iron Age*," xx., Aug. 2, p. 9.
Portable, Hydraulic, *Gerard*	* "*Iron Age*," xxii., Oct. 31, p. 7.
Hydraulic, *Gerard & Turnbull*	* "*Eng. & Min. J.*," xxvii. 150.
Houghton	* "*Sc. Amer.*," xxxvi 294
Automatic, *Leavitt*	* "*Sc Amer.*," xxxvii. 255
Lescale	* "*Sc Amer*," xxxix. 169.
Net on poles	* "*Sc Amer*," xxxix. 19.
Shishmanian	* "*Sc Amer.*," xxxviii. 147.
Ladder, *Winter*	* "*Sc. Amer.*," xli. 230.

Fire Ex-tin'guish-er. The subject of the portable or fixed apparatus, for projecting carbonic acid gas and water upon a fire, is considered on pp. 866, 867, "*Mech. Dict.*," including a reference to Sir William Congreve.

The larger apparatus, mounted as fire engines, are now in use in our cities, known as the Babcock Fire Engine.

Fig. 1035.



Fire Extinguisher for Mills.

The Anderson & Proctor apparatus, shown in Fig. 1035, is especially intended for mills, and is automatically operated through the medium of electricity, as described in § *c*, Fire Alarm, p. 849, "*Mech. Dict.*" Thermometers are placed freely at different parts of the establishment, and the raising of the mercury in either to a certain height completes a galvanic circuit, and opens a valve connecting by pipes with the special department from which the alarm proceeded and flooding it with steam.

See also the following: —

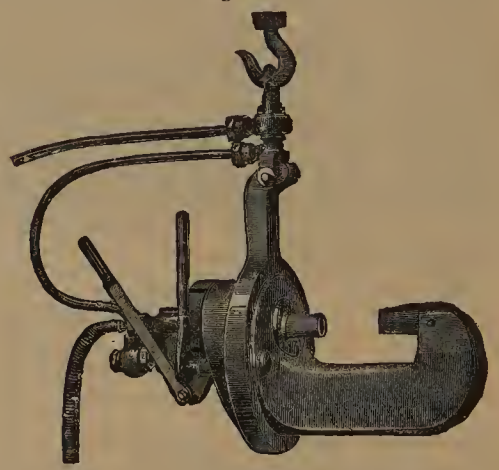
Apparatus, *Atlantic Fire Annihilator Co.*	* "*Man. & Builder*," viii. 145.
Compound, *Reec*	"*Sc. Amer.*," xxxvi 228.
Portable, *Douglass*	* "*Iron Age*," xxiii., June 26, p. 5.
On shipboard, *Granger*	* "*Eng. & Min. J.*," xxiii. 454.
	* "*Sc. Amer.*," xxxvi. 383.
Shipboard, *Thompson*	* "*Man. & Builder*," viii. 16.
	"*Sc. Amer.*," xxxviii. 101.
Automatic, *Tenner*	* "*Sc. Amer.*," xxxvii. 246.
Apparatus, "Tribune,"	"*Sc. Amer.*," xxxiv. 146.

Fire'-hole-ring Riv'et-er. The portable hydraulic riveter, for fire-hole-rings, originally designed by Tweddell for the special purpose of riveting up locomotive fire-hole door rings at Crewe.

The gap is 3.5″ when intended for locomotive work, and 5″ to 6″ when used for riveting on marine boiler front and back end plates.

This riveter is centered in a toothed wheel, which is put in

Fig. 1036.



Fire-hole-ring Riveter.

motion by a pinion, and the machine thus revolves in a vertical plane on its own center and in a very small space. A swivel joint between the outer *rock* and the suspending chain allows the riveter also to revolve freely in a horizontal plane.

The machine exerts a force of 33,000 foot pounds at each stroke, weighs 400 pounds, and can make 20 to 30 strokes per minute.

Fire'less Lo-co-mo'tive. A locomotive for street railways. That shown was designed for the Crescent City Railroad Company, of New Orleans, by Scheffler. Plate XV.

It has a cylindrical tank 31″ in diameter and 9′ long, with a capacity for holding 300 gallons of water, which is charged into it from a stationary boiler at a temperature due to a pressure of 220 pounds per square inch = 390° Fah. With this charge it runs about 6 miles, the pressure being down to about 40 pounds at the end of the run.

The driving wheels are 30″ in diameter, and the leading wheels 20″, with a wheel base of 5′ 7″. The cylinders are 4½ × 10″. The valve gear consists of a main valve, which works full stroke at all times, and controls the exhaust, with a steam valve on top worked by a link, which governs the admission. Both valves are, however, worked by the same link. The weight of the engine, with the tank full of water, is 8,700 lbs.

The Lamm & Francq motor, used on the Paris Railways, has a reservoir containing 1,800 liters of water at 400° Fah.

Francq, Fr.	"*Manufacturer & Builder*," xi. 9.
Lamm & Francq, Fr.	* "*Engineering*," xxviii. 306, 375.
	* "*Scientific American Sup.*," 1760, 2125, 2521, * 2766.
	* *Anderson's* Report, "*Paris Exposition Reports*," iv. 465.
Mekarski, Paris	* *Ibid.*, iv. 462.
	"*Iron Age*," xxiv., Nov. 27, p. 7.
Scheffler, N. O.	* "*Railroad Gazette*," xxi. 383.
	* "*Scientific American*," xxxvii. 239.
	* "*Engineer*," xliv. 220

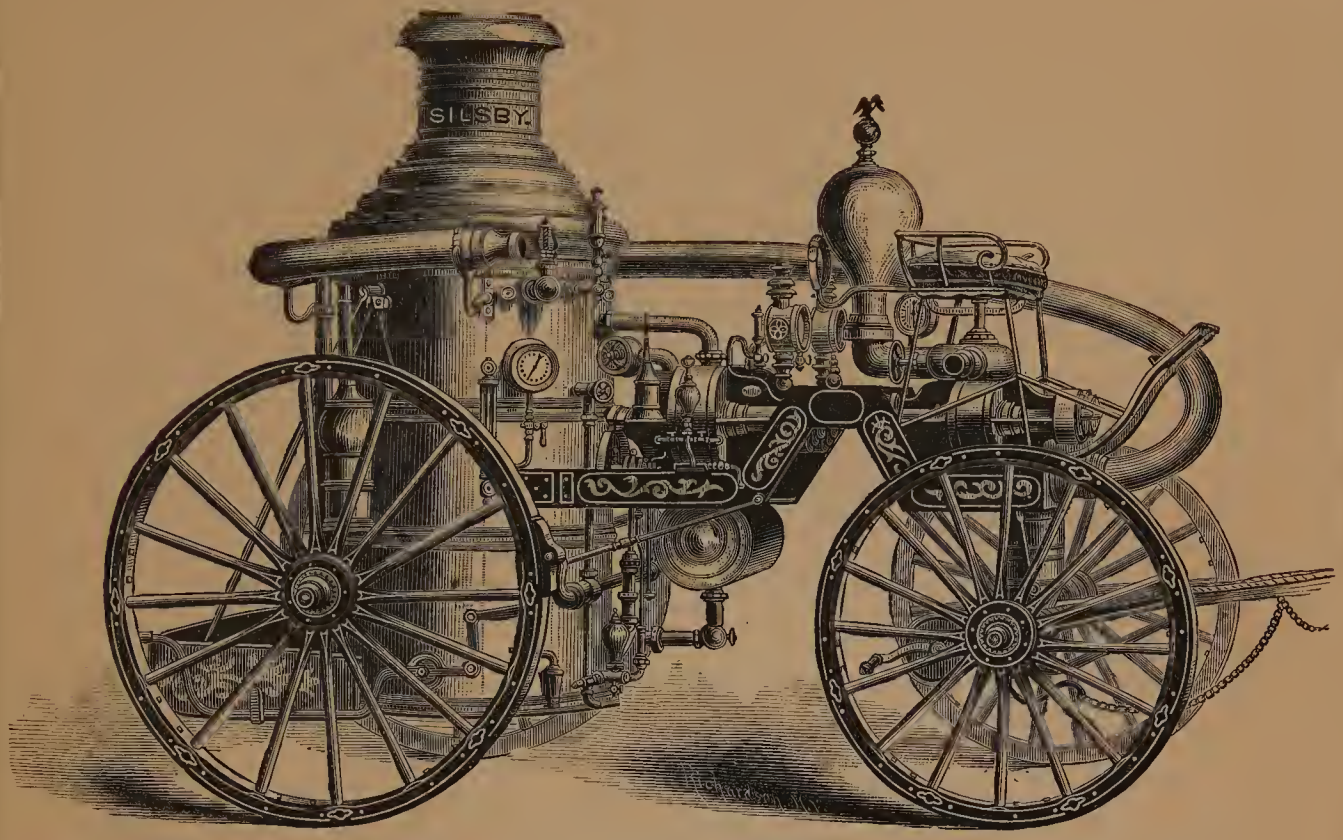
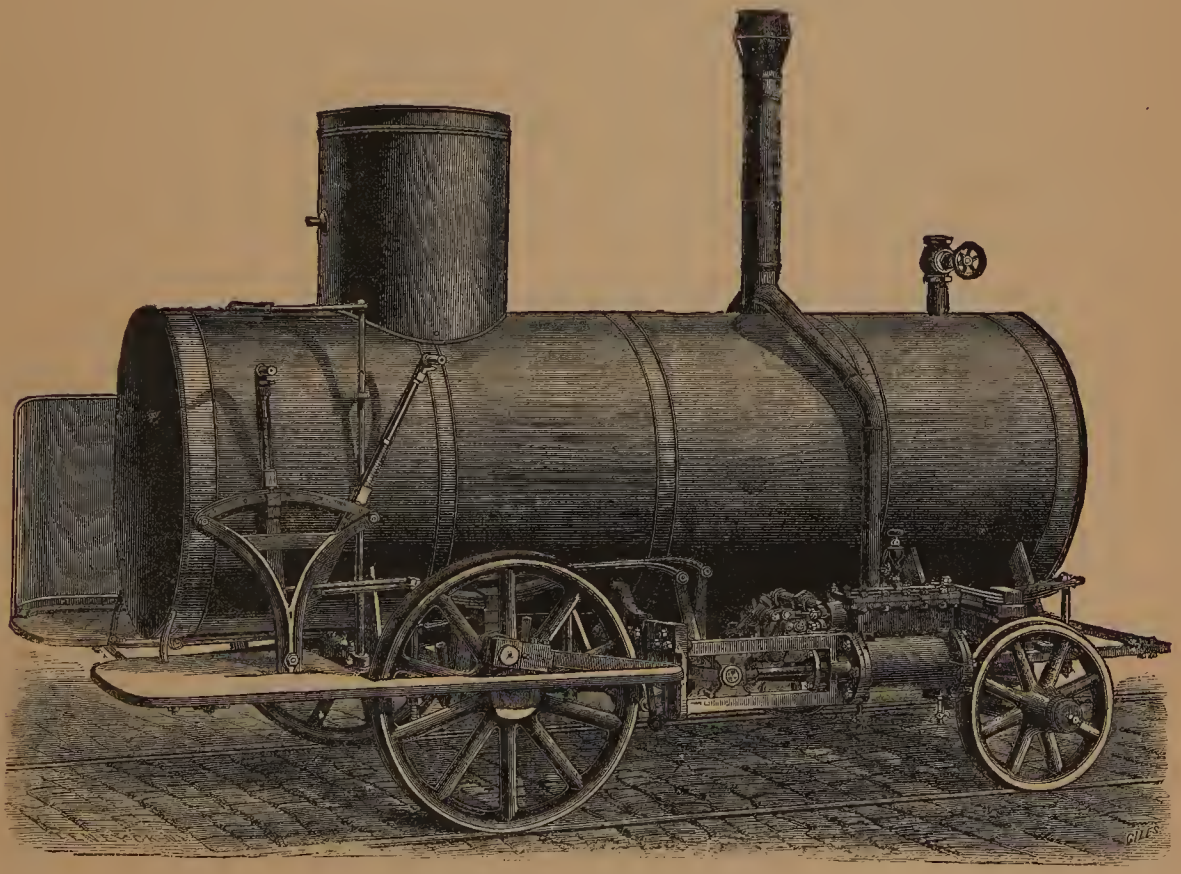


Figure 1031. *SILSBY FIRE-ENGINE.* *See page* 337.



SCHEFFLER FIRELESS LOCOMOTIVE.

(Crescent City Railroad Co., New Orleans.) *See page* 338.

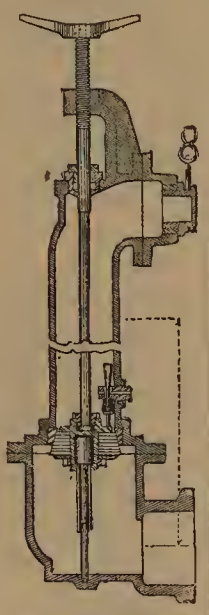
Fire'man's Axe. A chopping axe with a talon on the poll.

Fire'place Stove. A description of heater in which a close stove occupies the position of a parlor grate, has a protruding front and doors with mica panels. Also known as a *latrobe*. See Fig. 1998, p. 869, "*Mech. Dict.*" Fig. 2843, p. 1205; Fig. 5909, p. 2410, *Ibid.*

"Alhambra" . . * "*Scientific American*," xxxix. 261.
Ventilating . . . * "*Scientific American Sup.*," 1747.

Fire Plug. A device for connecting street mains with suction pipe of fire engine, or with hose for street watering or fire purposes. Used also in factories and large establishments of various kinds. See also FIRE COCK.

Fig. 1037.



Fire Plug (section).

Fire Pot. A solderer's furnace.

Fire-proof'ing. See following recipes and references: —

Wood: Follachi's plan. Place the wood on gratings and separated in a close vessel. Pump in following solution and boil.

Sulphate of zinc, 55 lbs.; potash, 22 lbs.; alum, 44 lbs.; oxide of manganese, 22 lbs.; sulphuric acid of 60°, 22 lbs.; water, 55 lbs.; all of the solids are to be poured into an iron boiler containing the water at a temperature of 45° C., or 113° Fah. As soon as the substances are dissolved the sulphuric acid to be poured in little by little, until all the substances are completely saturated.

Theatrical scenery: boracic acid, 5; sal ammon., 15; potassic feldspar, 5; gelatine, 1.05; size, 50; water, 100.

Fabrics: In 14 parts of water, heated to 180° Fah., dissolve 10½ lbs. gelatine and 21 lbs. castor-oil soap. Then add 10½ lbs. gum lac, shaking the liquid until the last is completely dissolved. Remove from the fire, and add in small quantities 21 lbs. powdered alum until the alum dissolves. This forms an insoluble alumina soap, closely incorporated with the gelatine and the gum lac. Apply with a brush.

Cloth: Apply tungstate of soda.

Or: a solution of 4 parts borax and 3 of sulphate of magnesia, which precipitates an incombustible and insoluble compound, the borate of magnesia, in the fibers.

Or: phosphate of ammonia, 5 per cent solution.

Or: solution of acetate of lime and chloride of calcium.

Or: sulph. amm. and sulph. calcium.

Or: 5 per cent. phosphate of amm. and 5 per cent. alum. Requires reimpregnation after washing.

Or: for cloth, 8 parts, by weight, of sulph. amm.; 2.5 parts carb. ammon.; 3 parts boracic acid; 1.7 borax; 2 parts starch in 100 water.

Canvas or cordage, wood or straw: 6 parts boracic acid; 15 parts sal amm.; 3 parts borax in 100 parts water.

Paper: 8 parts sulph. amm.; 3 parts boracic acid; 1.7 parts borax. Applied at 122° Fah.

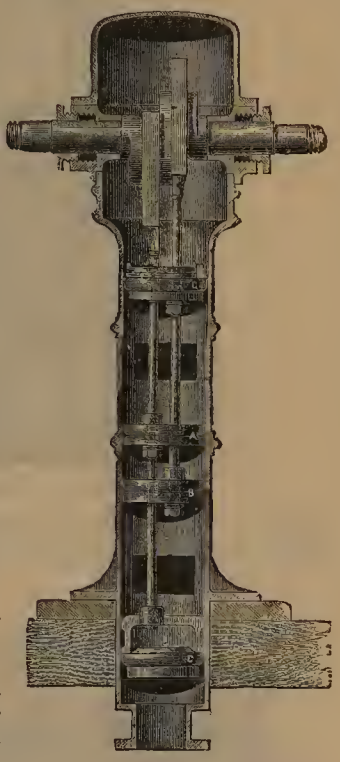
Paper: made from a pulp of vegetable fiber . 1.00
asbestos . . . 2.00
borax 0.01
alum 0.02

The ink is made of graphite . . . 85 00
copal varnish . . 0.08
copperas . . . 7.50
tinct. nutgalls . 30.00
indigo carm. . . *q. s.*

Buildings, "*Engineer*" . "*Van Nostrand's Mag.*," xvii. 439.
Cloth . . . . . "*Man. & Builder*," ix. 1.
"*Eng. & Min. J.*," xxvi. 333.
"*Sc. American*," xli. 218.
"*Sc. Am.*," xxxiv. 103, 405.
Concrete, "*Architect*" . . "*Van Nostr. Mag.*," xvi. 237.
Construction, *Bayless* . . "*Iron Age*," xix., Apr. 26, p. 22.
* "*Iron Age*," xxv., Jan. 15, p. 3.
"*Sc. American*," xxxvi. 104.
"*Sc. American*," xxxviii. 43.
* "*Sc. American Sup.*," 1363.
Hutton . . . . . "*Sc. American Sup.*," 158.
Northcroft, Engl. . . . . "*Sc. American Sup.*," 973.
Paper by *Schumann* . . . * "*Sc. Am. Sup.*," 2174, 2209.
* "*Polytechnic Review*," Dec. 23, 1876.
Curtain . . . . . "*Sc. American*," xxxvi. 277.
"*Iron Age*," xix., April 5, p. 7.
"*Iron Age*," xxii., Aug. 1, p. 18.
Dress . . . . . "*Sc. Amer.*," xxxv. 127 159.
Flooring, *Evans & Swain* . * "*Sc. American Sup.*," 1110.
Floors, roof, *Northcroft* . . "*Van Nostrand's Mag.*," xvii. 475.
Paper . . . . . "*Sc. American*," xli. 86.
Shutter, *Pollock* . . . . * "*Sc. American*," xxxix. 290
Theatrical scenery . . . "*Sc. American*," xli. 218.
Tower . . . . . "*Sc. American Sup.*," 557.
Walls . . . . . "*Sc. American*," xxxvi. 307.
Wooden buildings . . . "*Iron Age*," xix., May 10, p. 24.
Wood, "*Building News*" . "*Van Nostrand's Mag.*," xxi. 477.
Folacci . . . . . "*Sc. American*," xli. 103.
"*Sc. American Sup.*," 702.

Fire Pump. A pump designed to be used for extinguishing fires.

Fig. 1038.



Ship's Fire Pump, British Navy.

The Stone pump, shown by two sectional views taken in planes at right angles to each other (Figs. 1038, 1039), is the favorite pump in several European navies. The pump has three pistons, operating one above another in a single cylinder placed on the deck of a vessel and worked by hand cranks. The operation of the pistons is by a two-throw crank, and the suction pipes connect with either of six different parts of the vessel. The same pump may be used to draw water from the ship's reservoir; from a barge alongside to replenish reservoir; from the sea to wash decks or extinguish fire; bilge water from the hold, etc.

Fire Reg'u-la'tor. An apparatus which regulates the draft by governing the area of the air-duct or flues. In the instance shown in Fig. 1040, the pressure of steam in a chamber beneath the lever has the effect of turning the butterfly valve on its axis, and so increases or decreases the area of the duct. When the pressure of steam increases, the lever rises, partially closes the damper, and thus moderates the briskness of the fire: and *vice versa*. — *Le Van.*

Fish Cul'ture. A number of the devices used in modern fish culture may be reached by means of the following list of United States patents: —

No.	Inventor.	Invention.
68,871	*Green*,	A wire bottom box anchored. Inclined, to keep water flowing in at bottom.
72,177	*Drexter*,	A pen to inclose crabs, turtles, etc.
78,952	*Furman*,	Spawn chamber and receiver for young fish.
80,775	*Smidth*,	Air pumped through the sea water in chamber.
105,176	*Collins*,	A collecting screen beneath the spawning box.
116,112	*Stone*,	Box carbonized on inside.
116,995	*Sabin*,	Fish nursery. Spawning boxes.

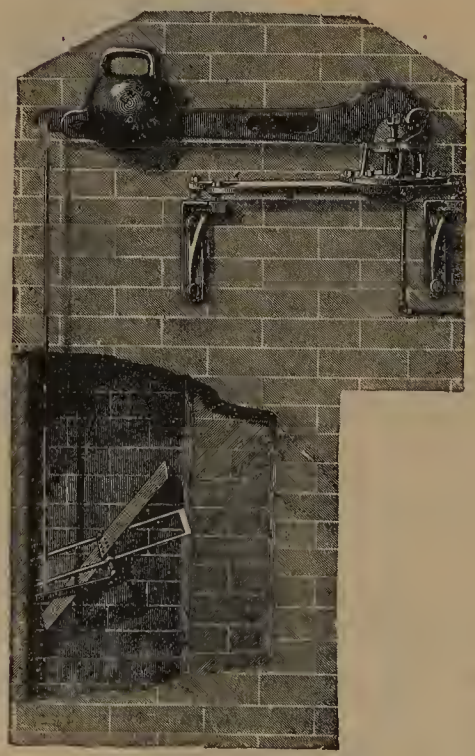
No.	Inventor.	Invention.
133,834	*Holton*,	Spawn trays with upward current.
148,035	*Clark*,	Hatching trays with artificial current.
149,198	*Clark*,	Eggs preserved in layers of moss in refrigerator.

Fig. 1039.

Ship's Fire Pump.

151,080	*Bryan*,	Floating anchored hatching box.
160,002	*Bond*,	Spawning trays and egg collectors.
166,413	*Roth*,	Egg basket and containing box in current.

Fig 1040.



Fire Regulator.

173,262	*Brackett*,	Hatching box with wire-netting bottom.
180,085	*Wilmot*,	Ova suspended in receptacle by upward flow.
199,527	*Ferguson*,	Ova in vessels mechanically agitated.
207,333	*Wright*,	Hatching box floats and its agitation lifts valves in the bottom and causes upward flow of water.

See also reports United States Fish Commission, and

Plaster casts of fish	"*Sc. Amer. Sup.*" 2003
Breeding apparatus	* "*Sc. Amer. Sup.*," 177.
Culture, *Pennell*	* "*Sc. Amer. Sup.*," 177.
Fish skin, numerous uses of	"*Sc. American*," xlii. 88.
Fish hatching (Havre de Grace)	"*Sc. Amer.*," xxxviii. 199.
Transporting carriage, Austrian	* "*Sc. Amer. Sup.*," 367.

Fish'er-man's Knot. The knot made in netting. Fig. 1041. It is the same as used in the neolithic age of Europe, as is proved by the fragments of nets found in the lake villages of the Swiss region.

Fig. 1041.

Fisherman's Knot.

Fish Flour. Fish flesh dessicated and ground into a flour of varying fineness, according to taste. Largely used in Norway.

Fish Hatch'ing Ap'pa-ra'tus. The most practical and instructive collection of this description of apparatus is in the Museum of the United States Fish Commission, Washington, D. C. It contains —

Models of hatching houses at Bucksport, Me., and Grand Lake Stream, Me.

Hatching apparatus of

Green.	*Stillwell & Atkins.*
Brackett.	*Holton.*
Williamson.	*Bannister.*
Furman.	*Roth.*
Clark.	*Bryant.*
House.	*Coste.*
Ferguson.	*Mather.*

Spawning screens of

Ainsworth.	*Bond.*
Collins.	

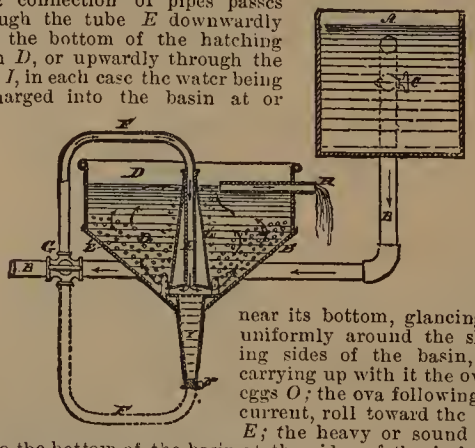
Transporting tanks and cans of

Mather.	*Stone.*
Stone & Hooper.	*Clark.*
Rogers.	*Wilmot.*
Atkins.	*Green.*
Slack. And numerous accessories.	

See list under FISH CULTURE.

Wilmot's apparatus, Fig. 1042, dispenses with a screen to prevent the loss of eggs with the overflow water and substitutes a regulation of the force of the water-flow so as to float off worthless matter, imperfect eggs, and prevent deposit of sediment on the ova.

Fig. 1042.



The water from the reservoir *A*, by a connection of pipes passes through the tube *E* downwardly into the bottom of the hatching basin *D*, or upwardly through the tube *I*, in each case the water being discharged into the basin at or near its bottom, glancing off uniformly around the slanting sides of the basin, and carrying up with it the ova or eggs *O*; the ova following the current, roll toward the tube *E*; the heavy or sound eggs fall to the bottom of the basin at the sides of the jacket or tube, to be again moved by the circulation of water; while the light or imperfect eggs, together with sedimentary sub-

stances in the water, pass up the outside of the jacket by the upward flow, and are carried off with the waste water through the spout *H*.

"*Scientific American Supplement*" . . . . * 629.

Fish Hook. The general run of the line of invention in this class may be gathered from the following list of United States patents: —

No.	Inventor.	Subject of invention.
6,207	*Johnson*,	Spring-hook; 21 kinds of hook and modes of attachment.
7,709	*Warner et al.*	Spring-hook.
8,853	*Buels*,	Trolling hook.
10,771	*Buels*,	Spring-hook.
10,761	*Siglers*,	Combination spring-hook.
13,081	*Cook*,	Spring-hook.
13,068	*De Saxe*,	Trolling-hook. A spring shield covers the point of the hook when fishing among weeds.
13,649	*Johnson*,	Spring-hook.
14,706	*Buels*,	Fly or trolling-hook.
17,803	*McLean*,	Self-setting trap-hook.
25,507	*Haskels*,	Trolling-hook.
31,396	*Morris*,	A spring draws the bearded points together into the fish.
43,694	*Leinhart*,	A trigger raises hooks which transfix the fish.
44,368	*Gardner*,	Spring-hook.
50,799	*Crandell*,	Combination double-lever hook.
51,651	*Davis et al.*,	Spring-hook.
59,814	*King*,	Spring-hook.
59,893	*Crosby*,	Fish-hook (flattened in bend).
51,951	*Livermore*,	Wire loop to prevent fish from stealing the bait.
54,251	*Johnson et al.*,	Spring or spear-hook.
54,684	*Chapman*,	Trolling-hook, with spring and fly.
58,404	*Goodwin*,	Spiral spring around the hook to press the bait down to point.
60,786	*Rhodes*,	Spring-hook, spinner.
62,042	*Lee*,	The shank made in form of spiral spring.
68,027	*Angilard*,	Lever-hook, and striking-hook to fasten the fish.
70,868	*Leinhart*,	Spring-hook.
70,913	*Sterling*,	One hook on swivel to hold bait, the other to grapple the fish while pulling from the water.
69,221	*Kidders*,	Spring-hook. Two hooks, separate when the fish bites.
77,365	*Fish*,	Hook.
79,446	*Christian*,	Trolling-hook, with artificial bait.
80,151	*Dennett*,	Spring-hook.
86,154	*Heltz*,	Hook, with an eye to attach hook.
94,893	*Kemlo*,	Lock-hook.
94,894	*Kemlo*,	Lock-hook.
94,895	*Kemlo*,	Grapple-hook, with guard to prevent fish from getting loose from barb.
95,755	*Angers*,	Three hooks. When the middle hook is pulled, it loosens the outer hooks, which expand in the mouth of the fish.
104,939	*Chapman*,	Propeller or trolling-hook.
111,898	*Arnold*,	Mode of attaching hook to line.
115,434	*Chapman*,	Propeller or trolling-hook.
117,719	*Arnold*,	Mode of attaching hooks to lines.
121,182	*Mann*,	Trolling spoon-hook.
123,844	*Sinclair*,	Trolling-hook.
129,053	*Pitcher*,	Hook, with double spear, to thrust into fish.
139,180	*Mullaly*,	Artificial fly, hook concealed by the wings.
141,910	*Allen*,	Hook has quadruple bends.
143,146	*Harper et al.*,	Trolling-hook with oppositely revolving spoons.
146,443	*Fitzgerald*,	A squid jigger, with a ring of prongs.
146,764	*James*,	A spinning-squid, with fins which revolve it.
148,926	*Cahoon*,	A mackerel jig, the hook secured in a socket.
149,123	*Hazzard*,	A trolling-spoon fish shaped.
151,394	*Huard et al.*	A spring fish-hook is inclosed in the artificial fish.
153,854	*Skinner*,	The spoon is corrugated to make it more attractive.
157,480	*Perry*,	Hooks spring outward when bait is touched
163,980	*Dunlap*,	Secondary spring-hook strikes the fish.
167,784	*Pierce*,	Two spoons, position controlled by springs.
171,697	*Place*,	Squid jigger, with a circle of prongs.
171,768	*Buel*,	Duplicate spoon fishing-tackle.
171,769	*Buel*,	Spinning-tackle; adjustable spring-hook on sliding ferrule.
177,639	*Hill*,	Spoon can move along the wire.
181,308	*Brush*,	Float attached to the shank of the troller.
184,627	*Jones*,	Swivel attachment for lines.
185,914	*Gregg*,	Artificial worm of rubber.
186,134	*Jahne et al.*,	A leader swiveled to the line and having two snoods.
189,805	*Smith*,	A circular system of pivoted hooks sprung inward.
190,222	*King*,	A pair of spring-hook claws.
191,165	*Miller*,	A supplementary pivoted spring-hook.
196,648	*Edgar*,	A tongue or mousing extending to the barb.
199,926	*Mitchell*,	Plunger driven into the mouth of the fish.
208,581	*Falvey*,	Rubber crawfish bait on an adjustable hook.
211,936	*Hill*,	Arrangement of movable spoon guide and rod.
218,345	*Wakaman*,	Artificial revolving minnow, with hooks.
223,194	*Vaché*,	Trigger and spring to jerk the hook.

Fish'ing and Whal'ing. The following list embraces the heads under this class: —

Accumulator.
Anchored net
Aquarium.
Axe.
Babiche.
Bag.
Bag-net.
Bait, artificial.
Bait box.
Bait cutter.
Baiting needle.
Bait knife.
Bait mill.
Bait-mill knife.
Bait net.
Baleen.
Baleen knife.
Banner netting.
Bar net.
Bar weir.
Becket hitch.
Blubber fork.
Blubber hook.
Blubber knife.
Blubber mincing machine
Boarding knife.
Boat hatchet.
Boat knife.
Boat spade.
Bob.
Bomb harpoon.
Bomb lance.
Bottom-set line.
Bowl.
Bull net.
Casting net.
Cast net.
Check stop.
Check knife.
Chopping knife.
Clam hook.
Clam knife.
Clamms.
Clap net.
Clearing ring.
Collecting seine.
Cork line.
Crab net.
Crib.
Cutting spade.
Dip net.
Dipping wheel.
Disgorger.
Drailing tackle.
Drails.
Dredge.
Dredging tube.
Drift net.
Drop net.
Eel bob.
Eel pot.
Eel spear.
Fatting knife.
Finning knife.
Fish-breeding apparatus.
Fertilizer.
Fish apparatus and processes for oil and manure
Fish cutter.
Fisherman's knot.
Fish grapple.
Fish-hatching apparatus.
Fish hook.
Fishing line.
Fishing line reel.
Fishing net.
Fishing rod.
Fishing torch.
Fish knife.
Fish nursery.
Fish preparing and preserving.
Fish slide.
Fish spear.
Fish transporting carriage.
Fish trap.
Fish-way.
Flitching knife.
Float.
Fly-hook.
Folding net.
Fyke net.
Gaff.
Gear.
Gill-net.
Grains.
Grapple hook.
Grappling gear.
Grappling tongs.
Gun harpoon.
Gunwale winch.
Half-round spade
Hammock net.
Handle net.
Hand line.
Harpoon.
Harpoon gun.
Hatching box.
Haul seine.
Head axe.
Heading knife.
Head knife.
Head spade.
Heart.
Heart net.
Heart seine.
Hook.
Hook net.
Horse net.
Ice chisel.
Ice chopper.
Ichthyocolla.
Isinglass.
Jack-lamp.
Jerk net.
Junk hook.
Lance.
Lance hook.
Landing gaff.
Landing net.
Land line.
Leader.
Latch.
Lever hook.
Lily iron.
Line (varieties, see list).
Line-hook.
Lint.
Lip hook.
Lock hook.
Mackerel latch.
Mackerel plow.
Mesh.
Meshing net.
Meter.
Mincing knife.
Mincing machine.
Mincing spade.
Minnow propeller
Net (varieties, see list).
Net machine.
Net-maker's knife.
Oyster culture.
Oyster dredge.
Oyster knife.
Oyster rake.
Oyster tongs.
Pew gaff.
Pisciculture.
Pocket net.

Pot.
Pound.
Pound net.
Probing awl.
Projectiles.
Propeller.
Purse net.
Purse seine.
Reel.
Ripping knife.
Rocket harpoon.
Scaling knife
Scoop net.
Seaming.
Seine.
Seine windlass.
Set line.
Sheath knife.
Sheave block.
Sinker.
Skim net.
Slivering knife.
Snood.
Spade.
Spawning screen.
Spear.
Spilliard.
Spinner.
Splitting knife.
Spoon.
Spoon bait.
Spring hook.
Spring net.
Squid jig.
Squid line.
Stake net.
Swivel.
Tackle.
Throating knife.
Throat spade.
Throwing line.
Tilting net.
Toggle liuc.
Tongs.
Torpedo.
Towing net.
Trailing net.
Trammel net.
Trap.
Trap net.
Trawl.
Trawl-boy swivel.
Trawling hook.
Trawl line.
Trawl line roller.
Trawl net.
Trolling bait.
Trolling spoon.
Trot line.
Tuunel.
Vat net.
Weir.
Whalebone.
Whaling apparatus
Whaling gun.
Whaling rocket.
Whalemau's knife.
Whaleman's tools.
Whiffing tackle.
Wide spade.
Wing.
Wing net.
Worm.

Fish'ing Line. See LINE.

Fish'ing Line Reel. The following condensed description of United States Patents will give an idea of the general tendency of invention in this line: —

No.	Inventor.	Invention.
854	*Tiffany*,	Rollers for seine line on rail of vessel.
15,466	*Bailey*,	Crank wheel thrown in or out of gear with reel.
16,626	*Deacon*,	Crank wheel thrown in or out of gear with reel.
24,987	*Billinghurst*,	Line winds on a skeleton ring.
27,305	*Palmer*,	Reciprocating line guide, to wind evenly.
41,494	*Dougherty*,	Friction brake to coutrol unwinding.
43,460	*Van Gieson*,	Frictional instead of positive connection between crank and reel.
43,485	*Ellis*,	Crank wheel can be disconnected from reel.
43,546	*Cummings*,	A spring catch and hook to counect reel and rod.
49,663	*Stuart*,	Reel in the handle; line passes through rod; arrangement for winding snug; disconnecting crank and reel.
55,653	*Hatch*,	Skeleton spool for line.
56,937	*Hartill*,	Mode of banging spool and "drag" on paying out of line.
71,344	*Vom Hofe*,	Arrangement for reel gearing.
78,546	*Stacy*,	An elastic gum nipper for hand lines.
82,377	*Bradley*,	Reel with two concaved disks.
83,740	*Stetson*,	A screw clamp holds the line sheave on the boat's gunwale.
87,188	*Mounier*,	A pivoted clamp holds the reel for the set line. A bell alarms when bait is taken.
88,026	*Foster*,	A mackerel latch; a button and line channel.
95,839	*Ross*,	A skeleton reel.
96,652	*Altmaeir*,	Reel set between two sections of the rod.
103,668	*Sheldons*,	Reel like a kite-string holder.
112,326	*Decker*,	Mackerel latch; a pinch grip beneath a cleat.
121,020	*Terry*,	Frictional device for angler's reel.
128,137	*Fowler*,	Annular reel of hard rubber.
134,917	*Mooney*,	Mode of attaching to rod and operating reel.
135,283	*Noe*,	Fan regulator connected to reel gear.
147,414	*MacCord*,	One reel may be quickly substituted for another.
150,883	*Orvis*,	Perforated disks to allow line to dry.
161,314	*Winans et al.*,	A friction brake to prevent overrunning.
162,845	*McDonald*,	A roller with several grooves on the gunwale.
166,241	*Winslow*,	Reel in the handle of the rod with an outer movable cylinder.
175,227	*Winans et al.*,	Reel cover and spring brake.
177,544	*Noe*,	Brake to prevent overrunning of the line.
191,813	*Philbrook*,	Reel with thin metal sides, and click mechanism.
195,578	*Copeland*,	Reel in the handle, with bevel gears and exterior crank.
214,495	*Dickson*,	Multiplying gearing in the cap.
216,243	*Voss*,	A crank and shaft in the dory to wind trawl lines.
219,328	*Vom Hofe*,	Construction of reel and control of motion.
220,776	*Wardwell*,	Crank can be disconnected from reel; a reciprocating guide for winding line.

Fish'ing Nets. The following condensed description embraces the principal features of the subject: —

647	*Evarts*,	Floating seine extended from boats.
763	*Hale*,	A square net alongside drawn into bag form, to inclose school of fish.
932	*Tracy*,	Seine with bottom and semi-circular sides.
3,004	*Cook*,	Gill-net, submerged. Small floats on seine line, and larger on surface of the water.
3,056	*Downs*,	Form for making nets for taking eels.
3,741	*Carr, Shannon & Co.*,	Fyke for eels.
10,794	*De Saxe*,	Landing-net with expansible frame.
20,125	*Hall*,	Seine with bag attached.
20,725	*Merritt*,	Net rigged overboard by booms.
24,887	*Goodwin*,	Leading nets and funnel entrances to slat trap.
39,676	*Randolph*,	Guide nets leading to pounds or shoal water.
55,635	*Field*,	A bag net.
56,917	*Ferl & Larkin*,	A drop net, Fig. 3317, "*Mech. Dict.*"
59,429	*Maxwell*,	Net, double, with rigid mouth, the inner being a funnel entrance.
62,481	*Crossman*,	Net, attached to side of boat, so as to be lowered or raised. Fig. 3318, "*Mech. Dict.*"
66,669	*Arnold*,	Net fabric.
72,177	*Drexel*,	Securing and feeding crabs.
76,284	*Will*,	Gill-net, with rings for sinkers.
76,387	*Bell*,	Net-attachment for boats, with guys to mast, to hoist or lower.
78,716	*Arnold*,	Mode of making nets.
80,274	*Collines*,	Perpendicular wooden braces extend below the sinker line.
82,490	*Cartwright*,	Set-net, to be anchored; the boat is attached about midway of the net, and a line is attached to small end of bag, and can be raised and emptied.
82,913	*Allen*,	Eel-pot.
83,493	*Harper*,	Bottom of seine longer than top, large sinkers.
83,429	*Wilcox*,	Pound net or trap.
87,740	*Wardmiller*,	Dip-net.
99,713	*Sabins*,	Purse-net, with bait-box, the net stretched on wires similar to umbrella.
113,292	*Hammond*,	Fish-trap net with two hinged flaps.
113,572	*Rider*,	Net-supporter, to swing with the tide.
113,817	*Tierman*,	Pound-net.
117,957	*Alexander*,	Bottom seine, with pursing lines.
120,974	*Jeffrey*,	Seine, with pursing lines.
124,635	*Smith*,	Purse seine, with a portion of its circumference depressed below the surface.
132,476	*Liraudais*,	Umbrella-shaped purse-net.
137,930	*Ketcham*,	A leader and heart conducting to a pound.
144,888	*Campbell*,	Stake for seines.
155,140	*Brewster*,	A leader heart and pound towed abaft a vessel.
167,189	*Nason*,	A landing-net.
194,434	*Howes*,	A bottom-net or pocket.
197,313	*Bates*,	A dip-net set on bottom.
215,031	*Webb*,	Pound net. See NET.

Fish'ing Rod. See the following list of United States Patents: —

10,795	*De Saxe*,	Hollow rod contains all the tackle; float has a trigger to jerk the hook.
20,309	*Underwood et al.*,	Tip has a sheave at the end.
25,693	*Pritchard*,	Line leaders on adjustable ferrules on rod.
35,339	*Vom Hofe*,	Sheave on the end of the rod.
58,833	*Isaacs*,	Enamel surfaces to line guides.
72,667	*Montrose*,	Rod has hinged sections and slipping ferrules.
100,895	*Hubbard*,	Parts of the socket are attached to each section, and screw together.
119,251	*Tout*,	Rod of laminæ of wood and whalebone.
137,015	*McHarg*,	Mode of securing the reel plate.
140,655	*Smith*,	Mode of locking the foot of one section in the socket of the other.
142,126	*Senieur*,	A post and socket to hold the foot of the rod.
154,141	*Hill*,	A mode of jointing the sections; a trigger and spring to jerk fish.

164,828 *Graves*, Line passes through center of rod.
169,181 *Leonard*, Mode of constructing the socket ferrules.
170,188 *Perry*, Fishing rod case of light wood, canvassed.
173,534 *Endicott*, Expansible guide and reel bands.
198,879 *Fisher*, Tip formed of a wire helix coiled into tubular shape.
206,264 *Robertson*, The butt is in two parts, one in the other.
207,655 *Leonard*, Split stay strips, to reinforce rod.
208,500 *Van Altena*, Reel contained in slot of rod. Line check.
222,681 *Earle*, The entering action has a cap which incloses the socket over which it slips.

Fish'ing Torch. Hamline; a ball of cotton is fed by a spout from a reservoir behind the reflector.

Wilson & Keagle; a wire gauze tube filled with asbestos, which forms the wick.

Fish Knife. A great variety of knives is found in use among fishermen, cleaners, curers, and packers of fish; for ripping, heading, crimping, and trimming of fish. Among them are the following: some of them are synonyms: —

Bait knife. For cutting up flesh for bait.
Bait-mill knife. Used on the rollers of bait-mincing machines.
Cheek knife. For trimming cod-fish.
Chopping knife. For mincing bait.
Clam knife. For opening clams.
Fatting knife. Used in creasing the sides of inferior mackerel, to make them resemble No. 1 mackerel.
Finning knife. For removing the fins of large fish.
Flitching knife. For slicing halibut, etc., into steaks or flitches, in preparation for salting and smoking.
Heading knife. For cutting off the heads of halibut, or other large fish.
Mackerel Plow. Also known as a *fatting* knife, for creasing the sides of lean mackerel to improve their appearance.
Net-maker's knife. A blade (2″) without a handle, and the heel of the blade curved so as to fit the finger like a ring
Oyster knife. A stout knife for opening oysters.
Ripping knives. For splitting the fish to remove the viscera
Scaling knife. For removing scales. Sometimes has a saw edge.
Sheath knife. The fisherman's knife, worn at the belt
Slivering knife. For slicing the flesh from the sides of fish to be used as bait.
Splitting knife. For ripping, and for halving the fish before salting.
Throating knives For opening behind the gills, and then ripping the fish. Frequently double-edged

Fish Nurs'er-y. A place where spawn is gathered and the young fish protected from the ravages of their natural enemies. See FISH CULTURE.

Fish Slide. (*Fishing.*) An inclined box set in a stream at a small fall or ripple to catch fish descending the current.

The open end of the box is presented up stream and the bottom being slippery the fish are dashed to the upper end of the box and scooped with a landing net
Used in the southern rivers of the United States to supply local demand for fish.

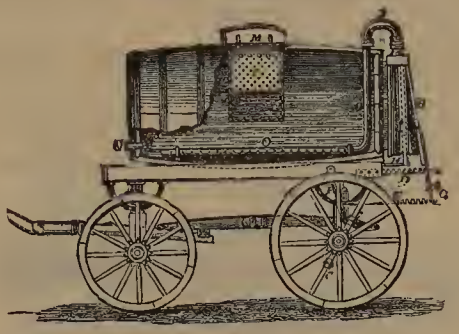
Fish Spear. A lance for bleeding captured whales, etc., or, on a small scale, a *leister* or *gig* for spearing fish from canoes or in holes of streams. See also GRAINS.

Fish Trans-port'ing Car'riage. The transportation of fish and of fish ova is an important consideration in fish culture, and many devices for packing ova and removal of fish from place to place have been devised.

Fig. 1043 shows a fish transporting carriage by Haïnmerle, of Austria. It consists of a large tank mounted, and with devices by which the running gear is caused to work the bellows and drive a continuous stream of air through the tank to aërate the water. The lever *F*, rod *E*, and spiral spring *D* operate the bellows *B*, forcing air through pipe *T* and distributor *O* into the tank. *M* is an ice tray and *P* a filter. *N*, draw-off cock. *G*, handle for working the bellows when the wagon is at rest. — "*La Nature.*"

See collection in United States Fish Commission Museum, Washington, D. C. Cans, barrels, tanks, force pumps, siphons, aërators, aquaria, bellows, dippers, etc.

Fig 1043.



Fish Transporting Carriage.

Fish Trap. A device set to catch fish. Snares, pounds, grapples, etc., come under this class. See also NET.

See also, DIPPING WHEEL, *supra.*

List of United States Patents

3,056 *Downs*, Forming blocks for making eel baskets.
7,709 *Warner et al.*, Spring grapple.
16,014 *Horton*, Spring grab hooks.
16,217 *Van Hosen*, Spring jaws and bait trigger.
20,343 *Garl*, Baited detent and spring nippers.
22,644 *Gray*, Slat cage, with expansible opening slats.
23,154 *Bowman*, Dark chute entrance to trap.
75,075 *Talbot*, Angler's tackle to signal when the fish takes the bait.
76,489 *McCaughan*, Set line with trigger and weight to strike and hook the fish.
77,893 *Koehler*, Set line with trigger and spring.
82,913 *Allen*, Eel pot with funnel of perforated sheet rubber.
85,199 *Beach*, Baited trigger and falling cage.
113,292 *Hammond*, Folding net of basket sections sprung by a line.
123,164 *Fuller*, Float with spring lever to strike when the baited hook is pulled.
131,439 *Harcourt et al.*, Self-closing trap door to cage.
132,476 *Livaudais*, An umbrella-shaped net closed by trigger and springs.
137,930 *Ketcham*, Pound of net has a funnel entrance and a door to close the entrance.
141,588 *Pavonarius et al.*, Cylinder with semi-circular door sprung by trigger.
156,648 *Peck*, Spring arm to throw baited lines.
178,375 *McRoberts*, Gravitating door lifted by entering fish.
188,503 *Davis*, For fishing in ice-holes; hooked fish makes signal
198,894 *McBryde*, Swinging gates and mirror for decoy.
201,504 *Davis*, Fish approaching bait press on spring fingers and enter cage.
202,818 *Hesse*, A spring lever to strike fish at the bait.
202,962 *Robertson*, A spring lever to strike fish at the bait, with reel to wind in line.
204,538 *Clark et al.*, Sunken cage with baited trigger and falling door.
215,031 *Webb*, Anchored seine with flaps and pockets.
218,737 *Henderson*, A glass vessel in a trap to hold live bait.

Fishing. Electric light under water, Fr "*Teleg J.*," iv. 32.
Fishing boats, Berlin Exposition * "*Sc Am. Sup.*," 3835.

Fish'way. The museum of the Fish Commission, at Washington, D. C., affords the best opportunity for study of this subject; and the catalogue of the collection contains detailed information. The devices are capable of classification, as

Gap.	Tunnel.
Groove.	Compartmental.
Step.	Spiral.
Box or pool.	Moving.
Inclined plane	Partitional.

55,929 *Steck*, A series of inclined planes in vertical series.
57,159 *Livermore*, Inclined series of chambers with tubular connections. Fig. 2003, "*Mech. Dict.*"
126,257 *Brewer*, Zigzag way in bottom of chute.
132,349 *Brackett*, Zigzag chute.
154,216 *Brewer*, Offset boards on bottom of chute.
208,408 *McDonald*, Force of water directed up the chute.
218,299 *McDonald*, Chambers and inclines in chute.

McDonald . . . * "*Scientific American*," xli. 275.
Rogers . . . . * "*Scientific American*," xliii. 22.

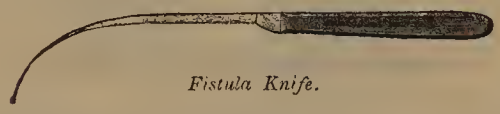
Fis'sure Knife. (*Surgical.*) A bistoury used in operations for anal fissure.

Figs. 586, 587, p. 124, Part III., *Tiemann's "Armamentarium Chirurgicum."*

Fis'sure Vein. (*Mining.*) A fissure or crack in the earth's crust filled with mineral matter.

Fis'tu-la Knife. A probe-pointed knife for fistula in ano. *Dr. Kelsey.*

Fig. 1044.



Fistula Knife.

Delicate knives are also made for *fistula lachrymalis:* bistouries also: CANALICULAR INSTRUMENTS are mentioned under that caption on page 157, *supra.*

Fit. In car-axles, that part upon which the wheel is forced.

Five Cant File. One for filing M-toothed saws. It has one angle of 108° and two of 36° each.

Fix'a-tion In'stru-ment. (*Surgical.*) A hook or forceps with delicate sharp claws to hold the eyeball steady during an operation.

Figs. 78-80 *d*, Part II., *Tiemann's "Armamentarium Chirurgicum."*

Fixed In'ter-val Reg'u-la-tor. (*Electricity.*) A form of polyphote regulator for voltaic arc lamps in which the regulation of the carbons is effected automatically at definitely recurring intervals of time. *Rapieff's* and *Brokies'* lamps are of this order.

Fig. 1045.

Fixed Piston Pump.

Fixed Pis'ton Pump. One in which the cylinder moves, the piston being relatively fixed.

Fig. 1045 represents the pump Donnadieu in which the valved piston *D e* is on the summit of the induction pipe *E L K*, on a base *M*. *H* is an outer cylinder in which the skirt *P* attached to the chamber *A B C G*, moves up and down. *d* is the eduction valve.

Flake Stand. The cooling tub or vessel of a still-worm.

Flak'ing Ham'mer. A steel hammer, bluntly pointed at each end and used in striking flakes from a flint nucleus. See Fig. 2, p. 18, *Evans' "Ancient Stone Implements of Great Britain."*

Flam'beau-let. A small torch, an allumette.

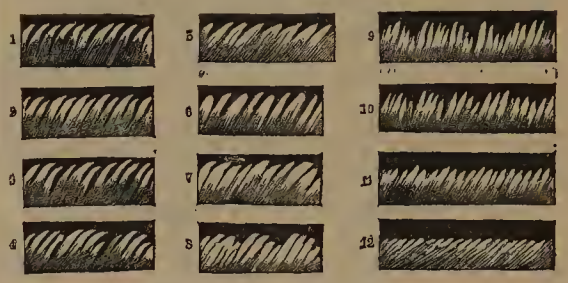
Flame'less Lamp. A lamp with incandescent spongy platinum. An *aphlogistic lamp.*

Fig. 1046.

Koenig's Flame Manometer.

Flame Ma-nom'e-ter. An instrument to obtain graphic representation of the condition of the human vocal organ. The invention of Koenig.

Fig. 1047.



Flame Pictures of Healthy and Diseased Voices.

It is composed of a large cube whose four vertical sides are covered with mirrors, and which is revolvable about a vertical axis; of a gas jet, burning with a small flame; and of a mouth-piece which terminates in a lenticular box or capsule. A very thin, tense, and impermeable rubber membrane divides this capsule into two compartments, in one of which the sounding tube terminates, while the other serves as a passage-way for the gas from the conducting tube to the jet at which it is burned.

On singing or speaking into the mouth-piece, sound waves are produced by the alternate condensation and rarefaction of the air within the tube; the rubber membrane acquires a corresponding rate of vibration, and so modifies continuously the rapidity of the delivery of the gas to the burner, causing the gas flame to leap up and down in unison with the sounds transmitted. On rotating the prismatic mirror this but slightly perceptible motion is rendered distinctly obvious, persistence of vision spreading out the image of the flame into a broad serrated band of light. These serrations vary with the character of the tones produced, as well as the degree of the diseased condition of the vocal chords In the latter case especially the difference in appearance of the image becomes so striking that a skilled observer can very readily form a correct idea as to the actual state of the vocal organs. The flame pictures shown in Fig. 1047 give some idea of the results: —

Series 1-4 are healthy notes in different pitches; highest above and the others successively lower

Series 5-8 are the same in pitch, but with a voice slightly hoarse

Series 9, 10 are the result of severe hoarseness.

Series 11, 12 are the result of disease, the voice being almost inaudible, glottis open, and the chords scarcely vibrating.

Fig 1048.

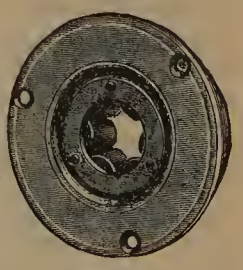
Flanges.

a Flange.
b. Bossed flange.
c Oval flange.
d Collar.

Flange. A plate for covering, or partly closing, the end of a pipe or cylinder.

Flange Bush'ing. A flange carrying a shell which acts as a bushing to a hole. In the example the bushing is for a block sheave and has anti-friction rollers.

Fig. 1049.



Flange Bushing.

Flange Coup'ling. A device for connecting pipes at any angle from 0° to 90°. It has two circular plates, each flat upon one side and having on the other a short internally-threaded tubular projection, inclined at an angle of 45° to the plane of the plates. The plates are slotted to receive the coupling bolts. Fig. 1050.

Flange Pipe. One having at the end (or ends) an annular projection with holes for bolts, by which it is fastened to a similarly-provided pipe or other object. See Fig. 2007, p. 876, "*Mech. Dict.*"

Flange Pul'ley. One with rims to keep the belt from running off. Fig. 1051.

Flan'ging Ham'mer. A machine for turning flanges on sheet-metal for boilers, tanks, furnace-

Fig. 1050.

Flange Coupling.

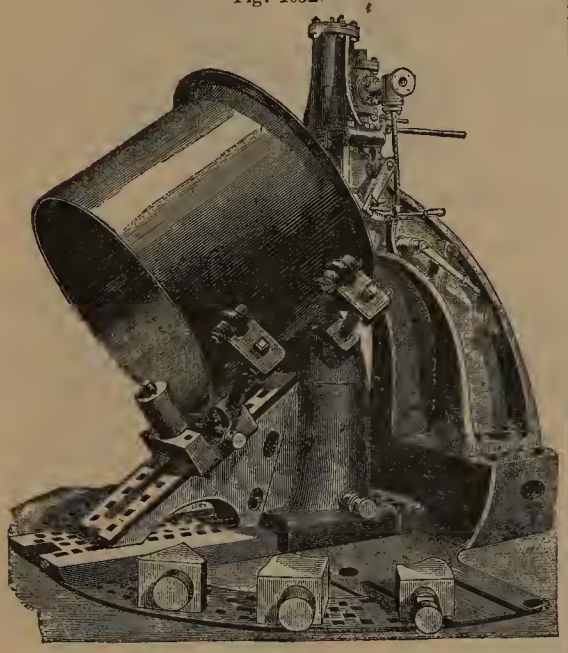
Fig. 1051.

Flange Pulley.

fronts, girders, parts of steam vessels, etc. The machines differ much in size and form, according to the requirements of special work and the size of the object under treatment.

In the machine of Campbell & Hunter, Leeds, England, the flanging block with separate anvil is mounted upon a

Fig. 1052.



Flanging Hammer.

swiveling slide, upon which it can be moved as required. The block has a projecting angular face in front, upon which is carried an adjustable roller or rollers for taking the end thrust of the flues, plates, etc. On each side of the roller carriage are two wrought-iron arms, and two others on each side of the anvil block, each arm having a small runner at the outside end; these arms keep the flue square, and the runners assist it when being turned round. For turning the flue round when flanging, two chain barrels with ratchet motion and sufficient chain are provided; these barrels are fixed in frames upon the foundation plate, one on either side of the flue: the chain is given a lap around the flue and is wound on to the empty barrel as it unwinds from the full one, or the flue can be revolved by hand. Flues up to 4′ in diameter can be done at one heat.

The anvil block is arranged to admit a variety of anvils for flanging end plates up to 15′ in diameter, tube plates, dished crown plates, etc., and for setting back the bottoms of vertical fire-boxes, and the guide block will admit heads to suit.

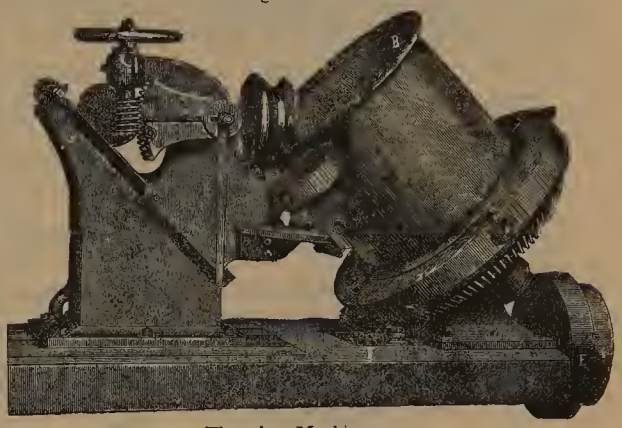
Campbell & Hunter . * "*Engineer*," l. 229.
* "*Scientific American*," xliii. 354.

Flan'ging Ma-chine'. (*Sheet-metal Working.*) One for making round and oval sunk-head cans, such as are used for packing butter, lard, etc., the heads of such cans being joined to the bodies by a double seam, without solder.

The flanging machine throws out the edge of the body, and the double-seamer closes the top (or bottom) in four movements; but at a single setting of the can, while it is either empty or full.

In Hanson's flanging machine (Br.), the steel roller, *A*, revolves on the end of a segmental rack, its angle of relation to the bending flange of the cylinder *B* being adjusted by

Fig. 1053.



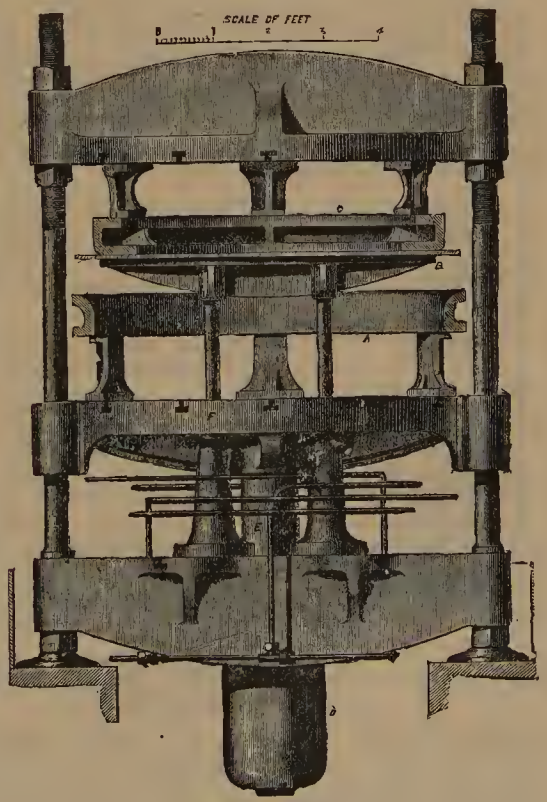
Flanging Machine.

worm wheel. Wheel *A* rotates by friction, and the cylinder by miter gearing from pulley *E*. The distance between the roller *A* and flange *B* is adjusted to suit various thicknesses of plate by means of the slide on the standard *G*, and the miter wheels on its summit. The roller *D* serves to guide and steady the cylinder.

Flan'ging Press. Fig. 1054 represents Piedbœuf's hydraulic press, for flanging, stamping, or straightening boiler plates. As illustrated, the press is arranged for flanging plates.

The plate to be flanged, having been heated, is placed on a ring, *A*, the interior of which is of a form corresponding to

Fig. 1054.



Flanging Press.

that to be given to the plate. This ring *A* is carried on columns which rest on the movable table *F*, this table being raised by the ram *E*, working in the hydraulic cylinder *D*.

The cylinder *D* is attached to a strong cast-iron frame, which is connected by the four columns to the fixed upper table.

In addition to connecting the upper and lower tables, the columns serve as guides for the moving table *E*, the latter being furnished with four bushes, which embrace the columns as shown. Four rams in the auxiliary cylinders are run up first, and by means of a table, *B*, hold the plate about to be flanged against the block *C* and prevent buckling, and as the table *F* is raised by the ram of the press, the plate to be flanged is pressed to the shape of block *C* by the passing over it of the ring *A*.

Brown, Br. . . . . * "*Engineer*," xlix. 173.

Flan'nel. 1. The first stage in the manufacture of plain cloth.

2. A class of woolen goods of various qualities and finish.

Domett flannels have a cotton warp and wool filling.

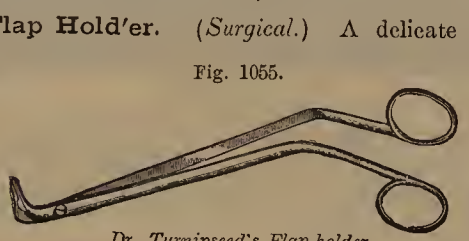
American blue flannel, for coating, is sheared and finished like cloth, but retains the lightness and pliability of the flannel texture.

French plaid is a fancy flannel; it consists of plaids, or broken plaids and checks, dyed in the wool.

See Hayes' "*Centennial Report*," v. 49–52.

Flap Hold'er. (*Surgical.*) A delicate pre-

Fig. 1055.



Dr. Turnipseed's Flap-holder.

hensile instrument for holding flaps of sutures in confined situations; in operations for vesico-vaginal fistula, etc.

Flashed Glass. (*Glass.*) Also known as *doubled-glass*. A glass made of several colors superposed; it is worked in a different manner from plain glass.

Colored glass is drawn into sticks of a certain length and annealed. A piece of this glass is heated, attached to the end of a blow-pipe, blown into a hollow ball. The ball is opened, and formed into a cup. A ball of white glass is blown by another workman and introduced into the cup. The two are blown and rubbed together while hot, to make them adhere.

The two are then treated as a single piece, and finished in any ordinary way by molds or tools.

Flash'ing. (*Hydraulic Engineering.*) Artificial assistance to navigation by ponding a river, and suddenly removing the barrier, to carry barges and rafts over shallow places in the stream.

"*Mech. Dict.*," p. 876. See also "*Barrage.*"
System on the Yonne, etc., Fr. "*Vienna Exposition Reports*," Watson's Report, iii. p. 27.

Flash Light Ap'pa-ra'tus. A device for automatically giving sudden flashes of light at specific intervals as a signal. Flash lights are used in lighthouses as a means of varying the character of the lighting. See LIGHTHOUSE, "*Mech. Dict.*"

The means adopted are large and small governors; the small one giving gas enough to keep the light going, and the larger one acted upon by a time-piece through the medium of electric arrangements. "*Journal of Gas Lighting.*"

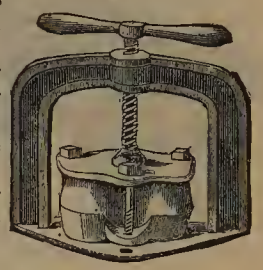
Peebles . . . . * "*Scientific American Sup.*," 1287.
Flash light on car "*Scientific American Sup.*," 979.
"*Mechanical Dictionary*," p. 877.

Flask Clamp. A dentist's clamp, for holding the flask in which the deuture is exposed to heat in the muffle. Fig. 1056.

Flat Bar Spi'ral Spring. One made by bending a flat bar so that its wide face is radial to the axis of the core or mandrel on which it is wound. *s*, *t*, *v*, Fig. 1143, p. 483, "*Mech. Dict.*"

Flat Cha'sing. (*Fine Art Metal-working.*) A mode of ornamenting silver ware, producing figures by dots and lines made with a punching tool.

Fig. 1056.



Flask Clamp.

Flat Coil. A heater coil, in steam or hot-water arrangements, the pipes of which are coiled so as to lie in a plane. Such are used against walls, for heating buildings, and on the bottom of evaporating pans.

Flat'-foot Ap'pa-ra'tus. (*Surgical.*) A curved steel sole worn inside the shoe to correct the abnormal flatness of the sole.

Flat Mir'ror. (*Optics.*) One for reflecting parallel rays; as distinguished from a *condensing* mirror, etc.

Flat Rib Knit'ting Ma-chine'. A machine for making shirt cuffs, bottoms for drawers, etc. Campbell & Clute.

Flat'ten-er. (*Blacksmithing.*) See FLATTER.

Flat'ten-ing. (*Leather.*) The same as shaving, except in some cases the skin after skiving is shaved across (*i. e.*, nearly at right angles to the skiving), and then flattened by being shaved again in the same direction as the skiving.

Flat'ten-ing Ov'en. (*Glass.*) A heated chamber in which split-glass cylinders are flattened for window glass. See Fig. 2014, "*Mech. Dict.*"

The usual style of oven has flattening, cooling, and piling-up sections. The flattening stone, supported on a small truck, runs on rails into the oven.

Segard, of Anzin, France, has two stoves carried on carriages, running on rails at different elevations, so that one can be returned while the other is going, one passing under the other. Work performed: 600 cylinders in 24 hours.

In another form of oven the cylinders are introduced into a compartment when they are heated, then flattened upon a stone carriage; the carriage is pushed into a compartment at the head of the *leer* (oven) and from the carriage the sheet is pushed upon iron bars which run longitudinally of the leer, and lie in channels sunk in the stone floor. The bars run upon rollers, and are lifted by a system of levers so as to raise the glass from the floor to move it along in the *leer* when another sheet is to be laid down. The sheets thus advance, step by step, till they reach the cool end of the oven, the bars after each forward motion being lowered and returned to their original position. The oven contains 9 sheets, which make the course in from 20 to 30 minutes.

Another form of *leer* has a rotating stone and compartments.

A form of flattening oven much used in France for baking colors on enameled glass consists of a leer, with compartments attached, for heating and flattening the glass. The flattening compartments contain the usual flattening stone mounted upon a carriage traveling back and forth upon rails from the heating to the flattening chamber. The *leer* contains a number of rollers mounted on cross shafts, and near enough to one another to give a sufficient resting support for the sheets of glass. These rollers receive a slow rotary motion. The cylinder being heated, flattened on the stone, run into the chamber opposite the mouth of the leer, the sheet transferred to the rollers which take it gradually and continuously to the discharge end of the *leer*. Both sides have a chance to cool.

See *Colnet's* Report, "*Paris Exposition Reports*," 1878, vol. iii., p. 239.

Flat'ten-ing Stone. (*Glass.*) A flat stone carried by a small truck running on rails, and carrying the cut-glass cylinder; the stone is run into the flattening oven to allow the glass to flatten out. See FLATTENING OVEN.

Flattening table, *Laboulaye's* "*Dictionary*," article "*Verre*," iii., Fig. 2544, ed. 1877.

Flat'ter. (*Blacksmithing.*) A swaging tool or fuller. *a*. Fig. 2124, p. 922, "*Mech. Dict.*"

Flesh'er. (*Leather.*) Or *Fleshing knife*. A long, two-handled and somewhat blunt-edged knife,

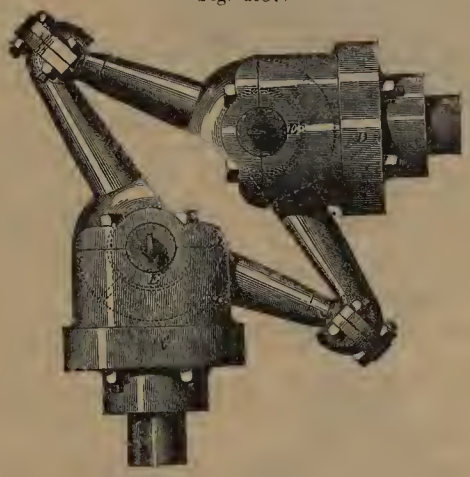
curved to fit the sloping rest of the beam. Its cross-section is concave downward. It is used to scrape off the hair, scarf-skin, loose flesh, and cellular tissue.

Flesh'ing Knife. (*Leather.*) A currier's knife used in removing cellular tissue, etc., from the hide. See FLESHER.

Flesh Side. (*Leather.*) The side of a skin or hide next to the flesh. As opposed to *grain* side.

Flex'i-ble Coup'ling. An angle joint for transmitting motion. A substitute for the gimbal.

Fig. 1057.



Clemens' Mechanical Movement.

The coupler arms are carried in pairs in their jaws by their hinge-jointed hubs on the pivot-pins *E*. The outer ends of the arms are coupled together by ball-and-socket joints. The weight preserves the balance. * "*Scientific American*," xxxv. 230.

Flex'i-ble Man'drel. A device for bending metallic tubes regularly and quickly, without flattening. It is a stout spiral of closely laid steel wire, preferably flattened so as to give extended bearing surface. Being introduced into a tube, any desired curve may be made; and by rotating the helix against its leading direction, it is made smaller, and may be withdrawn without difficulty.

Fig. 1058.

Flexible Mandrel.

Flex'i-ble Pipe Coup'ling. A connection for pipes which allows them to be laid out of line without leaking, and to expand longitudinally without impairing the joint. A tubular section with flanged ends fits in the bells of the respective pipes.

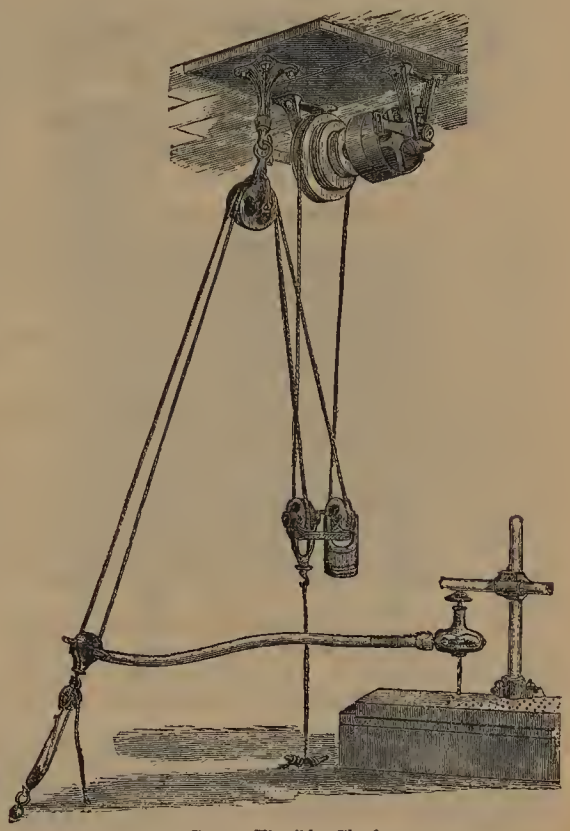
Fig. 1059

Flexible Pipe Coupling.

Flex'i-ble Shaft. A pliable power transmitter. A coil of steel wire is overwound with another spiral in a reverse direction, this by a third, and so on. The ends of the wires are brazed, and the whole covered with a hose. Its uses are numerous.

Thirion's flexible coupling was shown in Paris in 1867.

Fig. 1060.



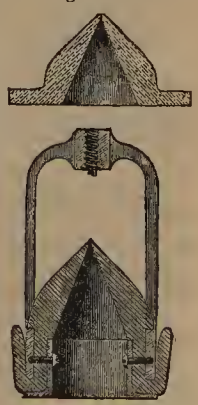
Stowe Flexible Shaft.

* "*Engineering*" . . . . . xxii. 40.
* "*Engineering and Mining Journal*" xxii. 75.
* "*Mining and Scientific Press*" . . xxxiv. 81.
* "*Iron Age*" . . . . . xxi., April 25, p. 1.
* "*Scientific American Supplement*" . 816.

Flex'i-ble Sole Plane. See CIRCULAR PLANE.

Flex'i-ble Valve. Perreaux's valve (French) of india-rubber opens as it descends, by the pressure of the water beneath, but closes against any pressure from above. It is used for lift pumps, especially in cases where it is required to pump liquids which corrode metals. They shut quickly, are durable and retentive.

Fig. 1061.



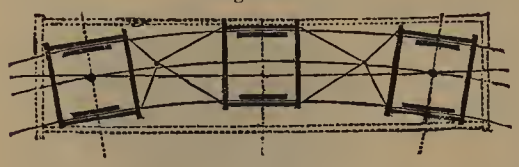
Perreaux's Flexible Valve.

The upper figure shows the form of valve, the lower one its application. It is so designed that, in addition to being a bucket valve, it forms a cup to keep the bucket tight in the barrel.

Similar valves have been made in the United States for deep oil-well pumps.

Flex'i-ble Wheel Base. (*Railway.*) A system of arranging car trucks, which consists in mounting the axles with their axle-boxes, guards and springs in frames separate from the main under-frame of the carriage. The end frames have central pivots, around which they swivel freely, while the middle frame is so arranged that it can slide transversely. The three frames are connected together by articulated radiating gear, so that they act sympathetically, and each axle assumes a position coincident with the radial lines of the curve, instead of remaining parallel to each other, as in

Fig. 1062.



Flexible Wheel Base.

the ordinary construction, in which the wheels grind their way along the sides of the rails. The wear and tear of ties and rails is thus greatly reduced, because the flanges of the tires are always parallel with the rails.

Flint Brick. A fire-brick made of powdered silex, with a sufficient flux to assist it to agglutinate at practicable temperatures.

Flint Glass. (*Glass.*) The use of calcined flints, to furnish silica for the glass, is the origin of the name.

In England, a glass containing lead. Called by French and Belgians *crystal*. Germans call all white glass *crystal*, whether or not lead enters into it; the Bohemian, for example, which has a potash and lime base; and ground quartz furnishes the silex.

The equivalent of what is called in England *white glass* is here known as *lime glass*, and is not equal in brilliancy to *flint* glass, which is an English invention, and that country produces the best specimens.

It is said to have originated in this way: When wood began to be scarce, and coal was substituted as a fuel, it was necessary to cover the glass pots to keep out impurities which colored the glass. As this diminished the heating power, it was difficult to melt the frit, and red lead was added as a flux.

Materials usually employed: —

Carbonate of potash	1
Red lead	2
Sand	3

Oxide of manganese in small quantities acts as a corrective of color.

Boracic acid has been used, and permits of the substitution of oxide of zinc for red lead, and of lime, soda, or baryta for potash. The result is a beautiful glass suitable for table-ware or optical purposes, remarkable for limpidity, whiteness, and brilliancy.

Flitch Beam. A beam made in layers of material pinned together. The invention of *De Lorme*. "*Nouvelles Inventions pour bien Bastir*," 1561.

The beam, specifically known as the *flitched beam*, is shown in Fig. 313, p. 139, "*Mech. Dict.*," and differs from the *laminated*, which is of thin and bent material, as in Figs. 312, 316, pp. 138, 139, *Ibid.*

See also "*Scientific American Supplement*," * 2035.

Flitch'ing Knife. (*Fishing.*) For slicing halibut, etc., into steaks or flitches, in preparation for salting and smoking.

Float. (*Fishing.*) 1. *Angling* line floats are of cork, quill, or light-wood.

Net floats are of cork, cedar, glass globes, rubber tubing, etc.

Harpoon-line floats are empty kegs, bladders, inflated seal-skins, etc.

The floats of the gill-nets of Lake Michigan are splinters of cedar, $30'' \times \frac{1}{4}'' \times \frac{3}{8}''$.

Glass floats are very common in Europe, having been used in Norway, Sweden, and elsewhere. Were shown in quantity at the Centennial in the Scandinavian department.

See the following patents: —

No.	Inventor.	Subject.
86,609	*Terrell*,	Made of hollow glass.
99,572	*Ingram*,	A wire loop above and pin below, lock the line.
127,218	*Brown et al.*,	Vulcanized rubber with projecting ears.
128,885	*Jewell*,	The float body has a longitudinal wire prolonged into a spiral at each extremity.
165,867	*Quinn*,	Board float loaded at one edge: for trawl lines.
179,490	*Sander*,	Net float with attaching slot.
186,232	*Davis*,	Glass floats for gill-net.
188,755	*Redfield*,	A spiral coil of wire at each end.

2. For raising sunken vessels. A camel or caisson. See those heads: also Fig. 4148, p. 1874, "*Mech. Dict.*" Fig. 1617, p. 688, and list under Hydraulic Engineering, *Ibid., et infra.*

Clark & Standfield * "*Scientific American Sup.*," 2071.

3. A ball on a lever, floating in a cistern to operate a faucet.

Benton . . . . * "*Scientific American*," xxxiv. 310.

4. A wooden trowel, to smooth a mortar surface.

5. (*Mining.*) Loose rocks, or such detached from the original formation.

Float'ing Board. A cast-iron plate, ribbed beneath and planed true on top, for "floating up" tin cans; *i. e.*, soldering the ends inside, the can standing upon the heated plate till the solder runs.

Float'ing Bridge. The landing platform of a ferry-boat; so called by Fulton in his description of the Hudson River ferry, started August, 1812. See Ferry-boat.

Hoogly, Calcutta . "*Van Nostrand's Magazine*," xviii. 475.
"*Scientific American Sup.*," 1897.

Float'ing Brush Dike. (*Hydraulic Engineering.*) A device to check the current of a stream and form a deposit.

It is made by taking saplings from 20′ to 30′ long and from 4″ to 8″ diameter, and nailing or wiring to them scraggy brush of any kind. This forms what is known as the *weed*. Instead of the saplings rope may be used to which to fasten the brush. One end of the weed is anchored and the other supported by a buoy. The weeds are placed in the river 10′ to 20′ apart, and check the current gradually without giving rise to the scouring action produced by a solid dike. A *willow curtain* acts in a similar manner.

See "*Report U. S. Engineers*," 1880, * ii. 1452. *Ibid.*, 1878, * ii 655, sketches Nos. 1, 2.

Float'ing Dam. An anchored dam.

Floating dam in the Dorran Canal, Vienna, * "*Engineer*," xli. 190.

Float'ing Dock. One which is floated beneath a vessel to raise it. See "Bermuda," Plate XIX., opp. p. 884, "*Mech. Dict.*" See also Depositing Dock, *supra*, and the following references: —

Float, *Clark & Standfield*	* "*Sc. Amer. Sup.*," 352, 2070.
	"*Marine Engineering News*," 1878.
	* "*Engineering*," xxvi. 119.
Paper on, *Clark*	* "*Engineering*," xxvii. 382.
Ponton, *Lauria*, Italy	* "*Engineer*," xliv. 188.
	"*Scientific Am. Sup.*," 1507.
Depositing, *Nicolaieff*, Rus.	* "*Engineer*," xli. 293, 294.
	* "*Engineering*," xxi. 311.
	* "*Engineering*," xxvii. 28.
	* "*Scientific American*," xl. 147.
	* "*Scientific Amer. Sup.*," 392.
Victoria Docks, Br.	* "*Engineer*," xlv. 272, 279.
Wheeden	* "*Scientific Amer.*," xxxiv. 182.

Float'ing Lev'er. (*Railway.*) A name applied to the horizontal brake-levers beneath the car-body.

Float'ing Wire Dike. (*Hydraulic Engineering.*) An open wire screen anchored at its lower edge and sustained by buoys along its upper. Its object is to arrest matters floating in the stream and by causing an obstruction obtain a deposit of sediment.

"*Report of U. S. Engineers*," 1880 . . . . p. 1452.

Flocked E-nam'el. (*Glass.*) Enamel ornamentation on glass whose surface has been previously dulled by grinding or acid.

Flog'ger. A bung-starter. An instrument for beating the bung stave of a cask to start the bung.

Floor Arch. An arch with a flat extrados.

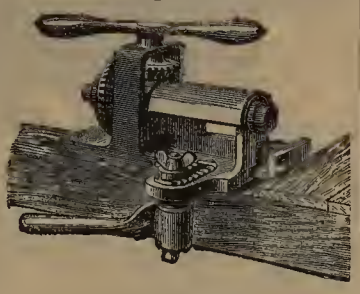
Floor-bor'ing Ma-chine'. One with a large and heavy bed-plate to which the work may be dogged while the drill press is moved to position to work upon it.

Floor Ce-ment'. A concrete for cellar floors and walks.

Broken stone or gravel and sand	4
Lime	1
Hydraulic cement	1

Mix the ingredients dry excepting the lime. Slack the lime separately and add it to the remainder. Work thoroughly and as dry as possible. Apply a thickness of 6″. When set add a coating of cement 1, sand 2.

Fig. 1063.



Floor Cramp.

Floor Cramp. A device for closing up the joints of flooring boards previous to nailing. Fig. 1063.

" Crown,"
"*Engineer*," xlv. 417.

Fig. 1064.

Floor Hanger.

Floor Fend'er. A knob fastened to a floor, to receive the impact of an opening door and thus protect the wall of the room.

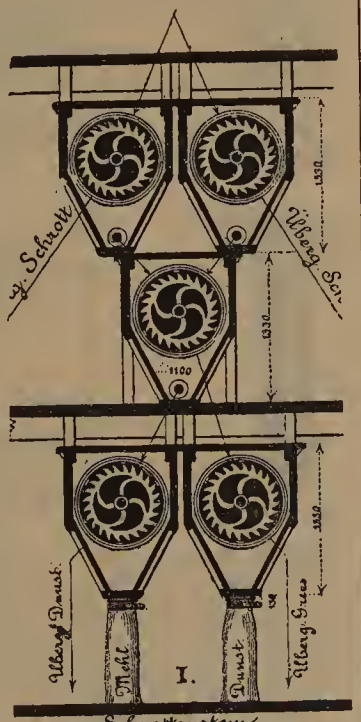
Floor Hang'er. A shaft bearing fastened to the floor. Used for running countershafts and lines when it is not convenient to suspend them from the ceiling joists.

Floor'ing Tile. Ceramic ware for paving. See TILE.

Floor Light. A frame with glass panes in a floor.

Flour Bolt. Fig. 1065 shows an Austrian arrangement for bolting meal. Each of the various cylinders makes a simple division of its contents and the ultimate division of the numerous grades is made by successive actions: Each cylinder rotates in a tight chamber, and has beaters inside to expedite the passage through the cloth of the finer particles. It is particularly intended for roller mills in which the work of grinding is by numerous successive actions, each detaching portions of flour from the material under treatment. See CYLINDER MILL, p. 243, *supra*, and HIGH MILLING, *infra*.

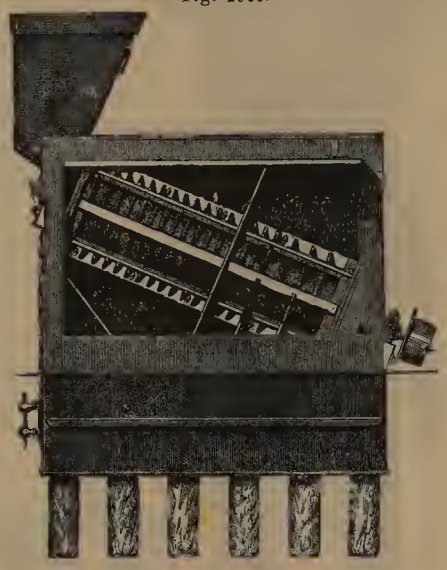
Fig. 1065.



Hoerde's Bolting Chests. (*Vienna.*)

Fig. 1066 represents a form of flour-bolting chest made by Ruston, Proctor, & Co. (Br.) The cylinder is of hard wood, covered with wire gauze of varying fineness. The shaft has horse-hair brushes; the feed is automatic, and the issues for the various grades of fineness discharge into separate sacks.

Fig. 1066.



English Flour Bolt.

The numerous successive boltings in the high-milling new process methods, and in the roller and cylinder mill processes have much increased the uses of the bolt.

See the following: —

Alger	* "*Scientific Amer.*," xxxv. 306.
Rathbun	* "*American Miller*," v. 124.
Shuttleworth & Morse	* "*American Miller*," viii. 39.
Chest, *Smith*	* "*Scientific Amer.*," xxxiv. 166.
" Troy," *Campbell & Suisher*	* "*American Miller*," iv. 62.
Dresser, " Victor "	* "*Scientific Amer. Sup.*," 2754.
Martin, Austria	* "*Engineer*," xlvi. 105.
" Victor "	* "*Engineer*," xlvi. 434.
Sifter, *Thomas*	* "*Scientific Amer.*," xlii. 50.

Flour Core. A dry-sand core in which flour has been used for the purpose of increasing the adhesiveness and strength of the sand when dried.

Flour Mill. See the following references: —

Detwiler	* "*American Miller*," vi. 101.
Oliver Evans	* "*American Miller*," vii. 1.
	* "*American Miller*," viii. 114.
Haxall, Richmond, Va.	* "*Scientific Am. Sup.*," 1731.
Large, Minneapolis	* "*Scientific Amer.*," xli. 291.
" Washburn, A."	* "*Scientific Am. Sup.*," 3913.
Portable, *Munson*	* "*American Miller*," vi. 209.
Mills in U. S.	* "*Scientific Amer. Sup.*," 589.
Roller mill	* "*Scientific Amer. Sup.*," 617.

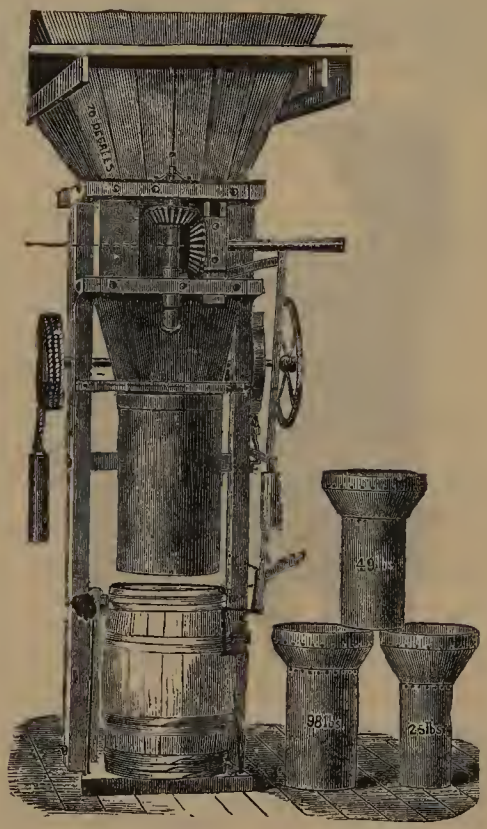
See also GRINDING MILL, ROLLER MILL, CYLINDER MILL, and list under MILL.

Flour Pack'er. A machine for barreling flour. A flour-chest and spout are made in accordance with the size of barrel to be packed by the machine. The horizontal shaft communicates motion by miter-wheels to the vertical shaft and auger which presses the flour into the barrel, the tube receding as the barrel fills. The machine is started by a simple movement of a lever, and stops automatically when the barrel is filled. By change of auger and spout it is adapted for any of the usual sizes of packages. A cut-off valve holds the flour in the bin when changing sizes. See Fig. 1067.

Flow'ing Bat'te-ry. (*Electricity.*) Or *perfluent* battery. One in which the battery is kept constant by the flowing of the exciting liquid through the cell or cells. See PERFLUENT BATTERY.

Flue. A duct for heated products of combus-

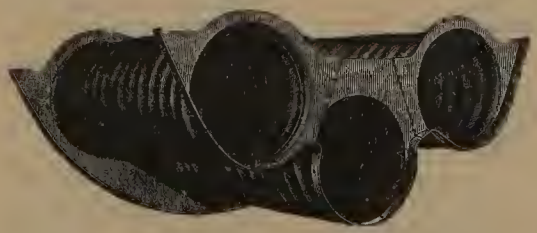
Fig. 1067.



Flour Packer.

tion ; a chimney. Fig. 1068 shows Fox's flue (Br.), in which the metal receives greater strength by corrugations.

Fig. 1068.



Corrugated Boiler Flue.

Flume. A long artificial channel or chute for conveying logs or lumber from an elevated situation to distant mill or works.

A chute for conveying water for use in hydraulic or placer mining.

"Cherokee" gravel mines * "*Min. & Sc. Press*," xxxv. 313.
Lumber . . . . . * "*Min. & Sc. Press*," xxxiv. 161.
California . . . . . * "*Sc. Am. Sup.*," 1840, *1509.
Smartsville Cal. . . . . * "*Mech. Dictionary*," p. 891.

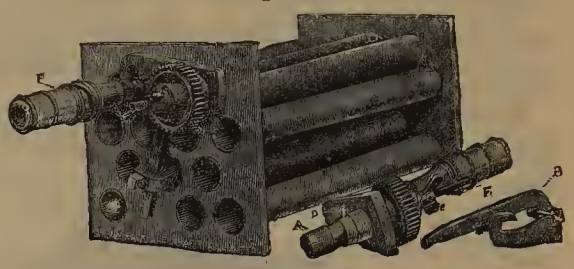
Flume Car. A car to travel in a flume ; wheels rest on the sides of the flume, and the water runs a paddle wheel.

"*Engineering and Mining Journal*" . . . . xxi. 223.

Flue Cut'ter. A tool for cutting out a faulty flue or tube, to be replaced by a perfect one.

Fig. 1069 shows a section of boiler with flue cutter in position for use, and the same in detail. The mandrel and tool carrier *A* is inserted in the flue to be cut off, and held in position by the clamps *B B*. The shaft is attached by means of the hand-piece *F*, which is also the means of starting and stopping the cutter when in use. The cutters *D* are forced out against and through the flue as it is cut, by means of the feed-screw *E*.

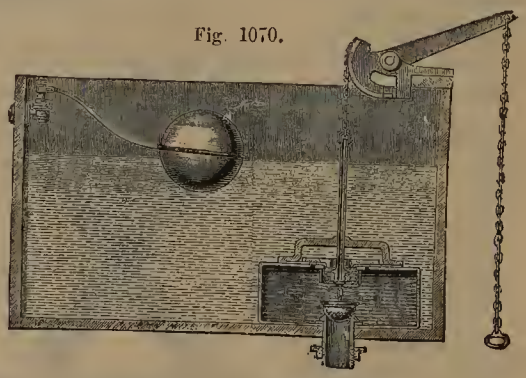
Fig. 1069.



Flue Cutter.

Flush Box. A cistern for especial use in dwellings where the supply of water is intermittent. The action of Morris's waste preventive flush box is follows : —

Fig. 1070.



Waste Preventive Flush Box.

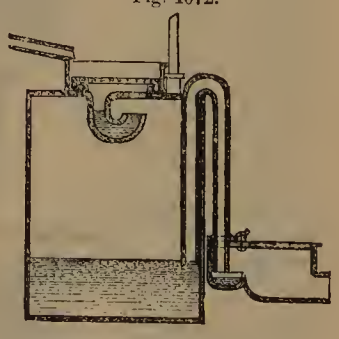
When the lever is pulled, it first closes the communication between the large cistern and the flush box, and then opens the outlet or discharge-valve, and is so arranged that in no case can the valve communicating with the large cistern and the discharge-valve be open or partially open at one and the same time ; so that no more than the contents of the flushing-box (about 2 gallons) can by any possibility be used at one operation.

Flush Deck Pump. One the upper surface of which is even with the deck, the chamber depending beneath. It has a hinged cover and the plunger is removable.

Fig. 1071.

Flush Deck Pump.

Fig. 1072.



Flush Tank.

Flush Tank. Field's flush tank is a cistern with a siphon which latter comes into action whenever the liquid attains a certain height in the cistern. It is adapted for the automatic periodical emptying of the cistern. May be useful apparatus in the periodical flushing of drains.

"*Manufacturer and Builder*" . . . * x. 280 ; * xi. 187.

Flu'ted Glass. (*Glass.*) A mode of treating glass to render it a perfect transmitter of light but prevent observation through it. Used in partitions, doors, and windows. It is much used in Europe, and has semi-circular flutings pressed into it.

It is made by blowing a pear-shaped piece which is then introduced into a brass mold having a number of deeply channeled flutings inside. The glass is now blown, as usual in cylinder blowing, and retains the imprints of the flutings. It is finished in the usual manner, care being taken not to rotate the ponty, as that would distort the flutings. The cylinder in expanding and lengthening reduces the depths of the flutes, but the flutings in the mold are sufficiently exaggerated to meet the flattening of the subsequent operation.

Flu'ted Tap. A tap for making screw holes. Longitudinal grooves in the sides, constitute the thread — cutting edges. See Fig. 6211, p. 2495, "*Mech. Dict.*"

Fig. 1073.

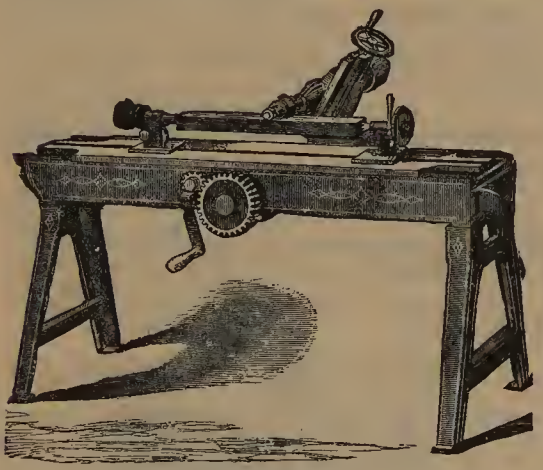
Fluting Iron.

Flu'ting Iron. A laundry iron for fluting clothes. There are many forms. See Figs. 2044, 2046, pp. 893, 894, "*Mech. Dict.*" The damp cloth is pressed between the two surfaces of the heated iron. Flutes may be nickel-plated.

Fluter, *Knox* . . . * "*Iron Age*," xviii., Sept. 21, p. 19.

Flu'ting Ma-chine'. One for grooving balusters, table-legs, etc. The stick is placed on centers

Fig. 1074.

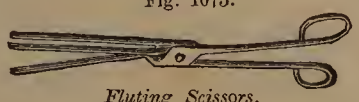


Fluting Machine.

as in a lathe and passed beneath the circular cutter which is mounted on a mandrel and rotated by band-pulley. See also FLUTING LATHE, Fig. 2045, p. 894, "*Mech. Dict.*"

Flu'ting Scis'sors. An instrument for fluting linen, etc. One member is hollow to hold a heated iron rod.

Fig. 1075.



Fluting Scissors.

Fly. (*Add.*) 13. The fore flap of a bootee. A strip of leather which overwraps the front vamp and receives the strings or other fastening.

Fly Hook. (*Fishing.*) One arranged with an artificial fly.

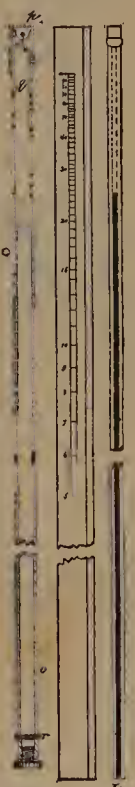
Fly'ing Ma-chine'. See references: —

Machine . . . . . "*Scientific American Sup.*," 1838.
Man, *Ignazio*, Italy . * "*Scientific Amer.*," xxxvii. 232.
Machine, *Ritchell* . . "*Scientific Amer.*," xxxviii. 405.
* "*Manufacturer & Builder*," x. 166.
Simonds . . . . . "*Scientific American Sup.*," 96.

Fly'ing Sound'er. A name applied to Sir William Thomson's deep-sea sounding apparatus. It consists of a glass tube lashed to a length of line above the sinker and connected to a line of pianoforte wire wound upon a reel from which it is payed out when sounding. By worm on the reel shaft, actuating gearing on a counter, the length of line payed out is shown, but the principal determination of depth is, after the tube has been hauled on board again, by means of the observed condensation of air in the tube when compared with a scale graduated to fathoms according to the known law of compression of air at given depths. The interior of the glass tube is lined with a preparation upon which the entering sea-water — or a liquid contained in the enveloping metallic tube acted upon by the sea-water — shall mark the distance that liquid has been forced into the glass tube, which may be said to constitute a pressure gage.

The intention is to measure the depth of water below the ship at any time without reducing her speed, but it is equally well adapted for taking soundings when lying to. As a matter of observation, in sounding from a steamer running at 14 knots in water of 70 fathoms depth, the sinker has been found to draw about 195 fathoms of wire off the reel and to take about 40 seconds of time to reach bottom. The counter driven by the wheel indicates the length of line payed out when bottom is reached and the depth may be instantly declared, if there has been sufficient experience in similar circumstances of apparatus, speed of ship, currents and weather, but the observation of the gage tube when brought on board again after sounding affords the more definite determination.

Fig. 1076.



Thomson's Deep Sea Sounding Tube.

The glass tube, Fig. 1076, is of sufficiently small bore to obviate the splashing of water within it during sounding. It is guarded by an outer metallic tube, o, which is attached by a length of hempen line to the wire. The lining of the tube is chromate of silver mixed with gum to enable it to adhere to the tube, and the mark is made by the chemical action of the sea-water which is forced out of the sheath into the tube as the apparatus descends. The action is to induce a double decomposition. The chlorine leaves the sodium of the common salt and combines with the silver, while the chromic acid and oxygen leave the silver and combine with the sodium. The chloride of silver, white and insoluble, remains on the glass in place of the yellow chromate.

The tube o, shown with its case *o*, and the graduated comparing stick in Fig. 1076, is closed at the upper end and open at the other (x), and slips within a metallic case o, the lower end resting upon a piece of vulcanite, *r*, to prevent shocks on reaching the bottom. The upper end *p* is removed for the introduction of the tube and then closed, the openings *q* allowing sea-water to enter as the apparatus descends. The lower end of the case *o* has a screw plug removable for purpose of cleaning.

Figs. 1077, 1078 show the apparatus in side and end elevations.

On the bed *A* are the standards *C L* which hold the reel *B* and the brake-drum *K* respectively. The reel is rotated by handles *D*, and on its axis is a worm, *F*, which actuates gearing *a b h i*, to revolve index fingers *f f* on the dials *l l* to indicate amount of wire payed off.

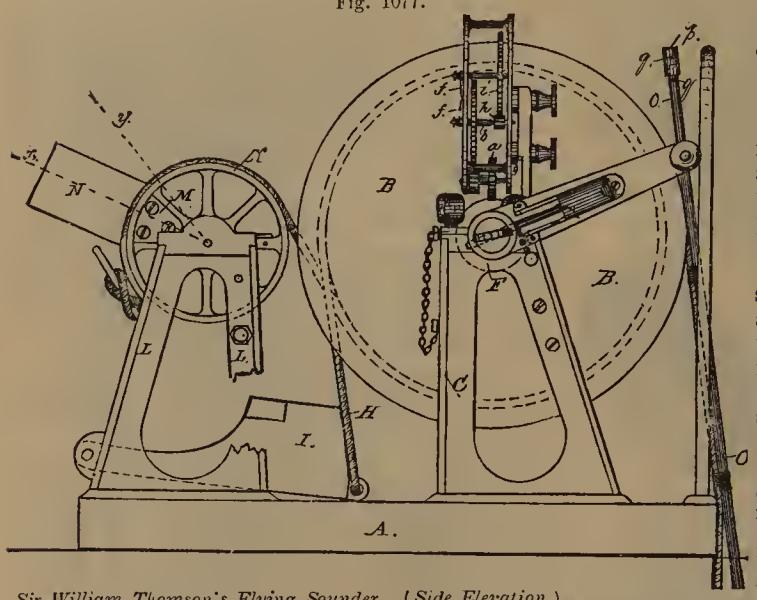
H is a brake rope which takes a turn round the drum *G* and is fastened at its respective ends to the brake-wheel *K*, and the pivoted weight *I*. *N* is a weight which exercises, in the position shown at x, a retarding force of 6 or 8 pounds on the drum, but which, when elevated, allows the brake rope to slacken so that the wire can be readily wound back on the reel after a sounding is had.

n n show the position of the sounding lead and *n'* its arming.

When it is desired to obviate the necessity of previous chemical or other preparation of the tube, a pressure-tube is used, open at each end and provided with valves, one at the lower end, to let sea-water enter when the sinker is going down, the other at the upper end to let air escape when it is drawn up, each of these valves remaining closed except when urged in its opening direction by a small definite amount of force.

Using this apparatus, the White Star steamer "Britannic" now takes soundings regularly, running at 16 knots over the Banks of Newfoundland and in the English and Irish Channels, in depths sometimes as much as 180 fathoms.

Fig. 1077.



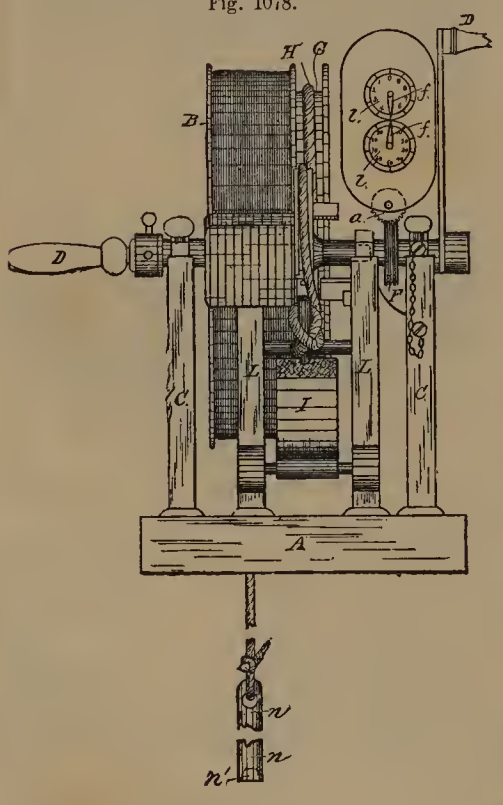
Sir William Thomson's Flying Sounder. (*Side Elevation.*)

The steel wire weighs about 1½ pounds per 100 fathoms and bears when new from 230 to 240 pounds without breaking. Its circumference is 0.03 inch.

See address of Sir William Thomson, Royal Society, February 4, 1878.

See also SOUNDING APPARATUS.

Fig. 1078.



Sir William Thomson's Flying Sounder. (*End Elevation.*)

Fod'der Cut'ter. A machine for cutting corn stalks for feed.

See ENSILAGE CUTTER; CHAFF CUTTER; STRAW CUTTER.

Fod'der Mill. 1. A mill for coarse grinding of grain for feeding stock.

2. A mill for grinding corn fodder, to render it more easy to feed in mangers, and more readily mixed with bran, or other enriching matter. A substitute for a fodder cutter.

"*Manufacturer and Builder*," * xi. 70.

Fog Bell. The fog bell of Zaffarini, of Ferrara, Italy, is rung by a rocking air-tight float, which carries a pair of erect hammers with pliable stems. See illustrations, p. 898, "*Mech. Dict.*"

Fog Gun. A signal gun, fired as a warning to mariners during foggy weather.

Explosive gas is sometimes used. See GAS GUN.

Major Elliott's account of the fog signal experiments at Dover, England, is found in his Report U. S. Engineers, "*European Lighthouse Systems.*" Referred to in "*Van Nostrand's Magazine*," xiv., pp. 109–111.

Wigham . . . . . "*Technologiste*," xxxix. 359.

Fig. 1079.

Fog Signal.

Fog Sig'nal. Nearly allied to the gun is the fog signal, made by the discharge of a ball of compressed gun cotton in the focus of a parabolic reflector.

See FOG BELL; FOG GUN; FOG TRUMPET, etc., "*Mech. Dict.*," *et infra*, and the following references:

Acoustic signals . . . . . * "*Engineer*," xli. 37, 46.
* "*Sc. Am. Sup.*," 183, 184.
Automatic, floating . . . . * "*Sc. Amer.*," xxxvii. 118.
Horn, *Barker* . . . . . * "*Engineer*," xlix. 411.
Horns, guns, whistles, etc. . * "*Engineer*," xli. 46.
Compressed air, *Sautter, Lemonnier & Co.*, Fr.
* "*Engineering*." xxx. 366.
Fog signals, paper by *Wigham* * "*Sc. Am. Sup.*," 2398.
Whistle, *Leighton* . . . . * "*Sc. Amer.*," xlii. 1.

Fog Trum'pet. The siren is a steam trumpet. See Fig. 5114, p. 2191, "*Mech. Dict.*"

The sound is caused by the passage of steam at 70 lb. to the square inch through the openings made by the revolution of one disk with radial slits cut in it in front of a similar disk fixed in the trumpet. The most effective rate of rotation is from 2400 to 2800 revolutions per minute. The trumpet is of cast-iron.

Fig. 1080 shows Brown's siren fog signal, the trumpet, valve, and rotating mechanism being mounted on a semi-portable steam boiler.

Steam is generated in *A* and passes to the valve *B*, which is a perforated disk mounted on an axis and rapidly rotated by a belt from the engine-wheel *D*, in apposition to a stationary disk similarly perforated, so that the steam passes when the holes come in correspondence, and thus causes a series of puffs. The *degree* depends on the pressure, the *pitch* on the rapidity of the succession of the puffs, the *duration* upon the time the throttle is left open, the *quality* upon questions relating to the material of the trumpet, shape of opening, etc.

The fog trumpet of Amadi, of Trieste, was exhibited at Vienna in 1873.

It consists of a trumpet, formerly operated by compressed air, but now directly by steam; is provided with an automatic distributing steam-valve, and with a special valve, with finger-board, to produce sounds of varying pitch.

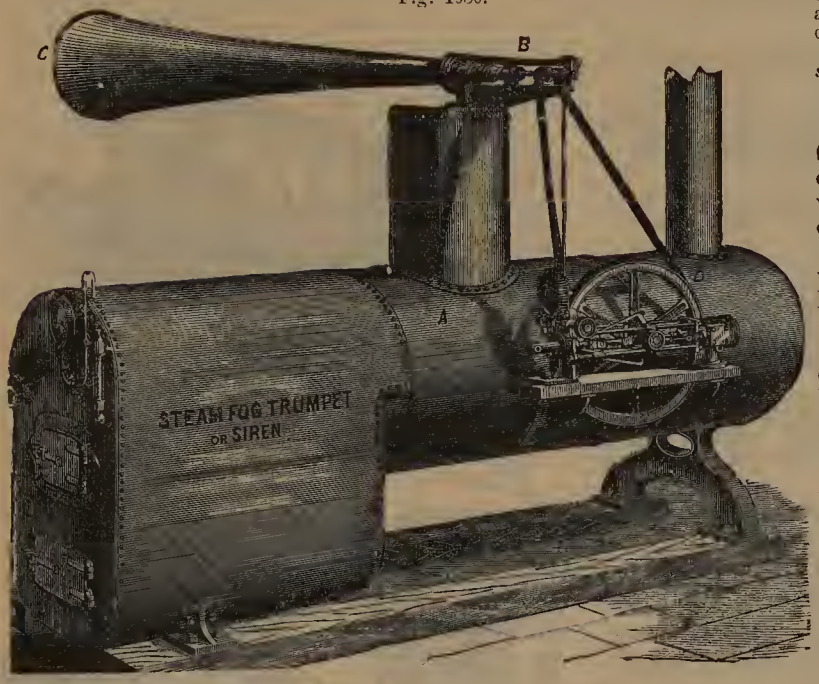
This trumpet, set up on Point Salvore, Istria, is operated by an 8-horse power steam boiler, at 25 lbs. pressure; can produce 30 blasts in 30 seconds, and is audible at 15 nautical miles distance in clear weather.

Report of Major George H. Elliott, Corps of Engineers, U. S. Army. Van Nostrand.

See also "*Van Nostrand's Magazine*," xiv. 105.

The ordinary fog-horn is a brass trumpet 8′ 6″ long, 3″ diameter at the mouthpiece, and about 23″ at the mouth. It

Fig. 1080.



Brown's Siren Fog Signal.

has a steel reed, 10¾″ 3″ wide, ¼″ thick, which is adjusted to suit the fundamental note of the trumpet, and made to vibrate by air at 18 lb. pressure.

Fog Whis'tle. For data on fog whistles and fog horns see *"A Summary on Researches in Sound by Professor Henry during* 1865–1867," *"Smithsonian Report,"* 1879, and *"Mech. Dict.,"* p. 898.

Leighton's whistle, shown partly in section in Fig. 1081, is intended to reënforce the sound of a steam whistle. It con-

Fig. 1081.

Fog Whistle.

sists of a fog-horn containing a steam whistle, behind which there is an adjustable resonance chamber. The whistle has straight parallel sides and straight orifices.

Foil Car'ri-er and Plug'ger. A species of pliers for grasping foil or other filling and with curved ends which, when brought into apposition, form a plugging tool.

Foil, Va'ri-e-ga'ted.

Japanese: Thirty or forty thin plates of gold, silver, copper, and various alloys, are laid one over the other in a given order, and soldered together at the edges, so that the whole forms a stout plate of metal Punches of various shapes, conical, pyramidal, with triangular, square, or pentagonal sides, are now used to make a pattern of perforated figures, which exhibit on their inner sides concentric circles, triangles, and other forms, corresponding to the punches used. The plate so prepared is hammered and rolled until it has become quite thin, the holes disappear, and the figures have spread out, preserving, however, their parallelism. A number of broken, straight, and curved lines are thus produced, which, as in a Damascus blade, are free of each other, though consistent in themselves in the same metal, their effect being further enriched by the use of acids to modify the colors. It will easily be understood that thin plates prepared in this way, having an extremely flexible nature, admitting relief, with stamped or engraved designs, and capable of receiving the most various colors and forms, will have many uses in decorative art. — *Prof. Lielegg.*

See DAMASKING METALS, p. 245, *supra.*

Fold'er. (*Sheet Metal Working.*) A machine for turning locks or tapping edges of cans. Being adjustable, it will turn narrow or wide locks, or round edges for wiring.

Fold'ing Boat. See list under *Boat,* p. 114, *supra,* and Fig. 2057, p. 899, *"Mech. Dict."*

Fold'ing Ma-chine'. (*Sheet Metal Working.*) A machine for folding the edges of blanks preparatory to seaming. Generally called a *double-edging machine.*

(*Printing.*) A folder attached to a perfecting printing machine.

(*Bookbinding.*) A machine for folding sheets, signatures, or quires.

Quire, *Richmond,* Br.
* "*Engineer,*" l. 314.
Folding and perforating, Lawrence, Br.
* "*Sc. Am. Sup.,*" 2096.
* "*Iron,*" 1878.

Fold'ing Net. (*Fishing.*) One made to shut together to inclose the prey. A *purse* net is a variety.

Food Car. One used in a hospital or asylum to convey rations or food to the wards.

Foot Ap'pa-ra'tus. (*Surgical.*) Includes:

Apparatus for eversion.	Artificial feet.
For club-foot (talipes).	Support for weak ankles.
Apparatus for flat feet.	For short leg.
Splints, bandages, and slings, for fractured or luxated parts.	Contracted tendo achillis.
	For over-riding toes.
	For bunions, etc.

Foot Pow'er. The baromotor of Gaston Bozérain, of Paris, is a combined treadle and hand-lever motor. Shown at the Paris Exposition, 1878.

* "*Man. & Builder,*" ix. 280.
* "*Sc. Am.,*" xxxvii. 242.
Foot power, *Lane* . . . . * "*Sc. Am.,*" xxxix. 294, 370.
Foot drill, *Pratt & Whitney* . * "*Iron Age,*" xviii., July 6, 1.
Foot lathe, *Cornell Univ.* . * "*Engineering,*" xxv. 240
Shepherd . . . . . * "*Iron Age,*" xx., Aug. 2, 28.

Foot Vise. A device used in the smaller operations of blacksmithing; making calks on horseshoes, heading bolts, etc.

Fig. 1082.

Foot Vise.

Foot Wall. (*Mining.*) The layer of rock immediately under the vein.

Foot Warm'er Heat'er. Apparatus for warming the contents of the foot-pans which are used in the railway cars of Continental Europe to warm the feet of the passengers. In the apparatus on the Paris, Lyons, and Mediterranean Railway the injection of steam has

substituted the emptying and refilling with hot water.

The apparatus at a station will heat 240 foot-warmers per hour to a temperature of 185° Fah.

Paris, Lyons, & Med. Ry. . * "*Engineering*," xxvii. 111.
* "*Scientific Amer. Sup.*," 2794.
Verloop, Ger. . . . . * "*Engineering*," xxx. 208.
W. Ry. of France . . . . * "*Engineering*," xxviii. 225.

For'age Cut'ter. A chaff cutter. See ENSILAGE CUTTER; STRAW CUTTER, "*Mech. Dict.*"

Russian military ration of forge: —
Biscuits of oatmeal, pea flour, rye meal, ground linseed; 28 small biscuits a ration. The nutriment equal to 12 lbs. oats, at one-fifth the bulk.

For'age Press. See BALING PRESS, Fig. 184, p. 69, *supra*.

Force. The upper die in a stamping machine. In zinc stamping the workman has various irregular shapes to manage. See description in "*Iron Age*," xxiii., March 6, p. 27.

For'ceps. (*Surgical.*) A grasping tool, having two parts hinged scissors-fashion. The names are generally descriptive of the purpose, or of the part to which they appertain. The list following is derived from "*Tiemann's Armam. Chirurgicum.*" See also list on p. 903, "*Mech. Dict.*" The larger number of the instruments here cited are to be found under their alphabetical captions in this volume or in the "*Mechanical Dictionary*."

List of surgical forceps: —

Alligator.
Arrow extracting.
Artery.
Bone-cutting.
Bone-holding.
Bull-dog.
Bullet.
Canulated.
Caustic.
Cilia.
Clamp.
Conjunctiva
Craniotomy.
Curvilinear.
Dental.
Depilating.
Dilating.
Dissecting.
Dressing.
Ear.
Embryotomy.
Entropium.
Epiglottis.
Epilating
Extirpation.
Eye.
Eyelet.
Fenestrated.
Fixation.
Gouge.
Gullet.
Hare lip.
Hemorrhoidal
Iris.
Laryngeal.
Lens.
Ligating.
Lithotomy.
Luxation.
Microscopic.
Midwifery.
Nail extracting.
Nasal.
Necrosis.
Needle holding.
Obstetrical.
Phymosis.
Pile.
Placenta.
Polypus.
Punching.
Rongeur.
Root.
Sac.
Saw.
Seizing.
Self-holding.
Sequestrum.
Slide catch.
Spring catch.
Spicula.
Splitting.
Sponge.
Strabismus.
Tenaculum.
Throat.
Tissue.
Tongue.
Tooth.
Torsion.
Tracheal.
Trepanning.
Trichiasis.
Twisting.
Urethral.
Uterine.
Vulsellum.
Wire cutting.
Wire twisting.
Wisdom tooth.

Fore Car'riage. The frame and pair of wheels on which the front end of the beam rests in many forms of European plows.

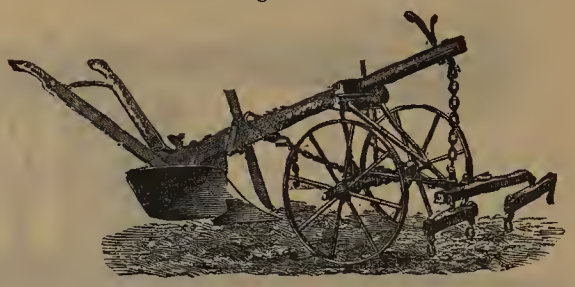
Fore'-end. (*Fire-arm.*) The wooden piece under the barrel forward of the guard.

Fore'-hearth. (*Metallurgy.*) The forward extension of the hearth of the blast-furnace; it is closed by the *dam*. Fig. 704, p. 293, "*Mech. Dict.*"

Fore'lock. (*Nautical.*) The wedge passing through a mortise in the shackle of an anchor.

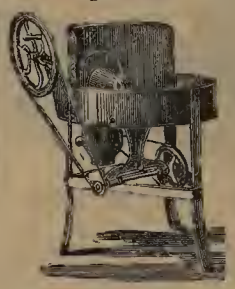
Forge. (*Metallurgy.*) *a.* A form of furnace for obtaining iron by direct process from the ore. See BLOOMARY; DIRECT IRON PROCESS; IRON PROCESS; HEARTH, etc.

Fig. 1083.



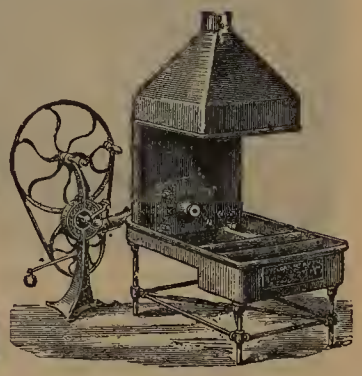
Fore Carriage.

Fig. 1084.



Portable Forge.

Fig. 1085.

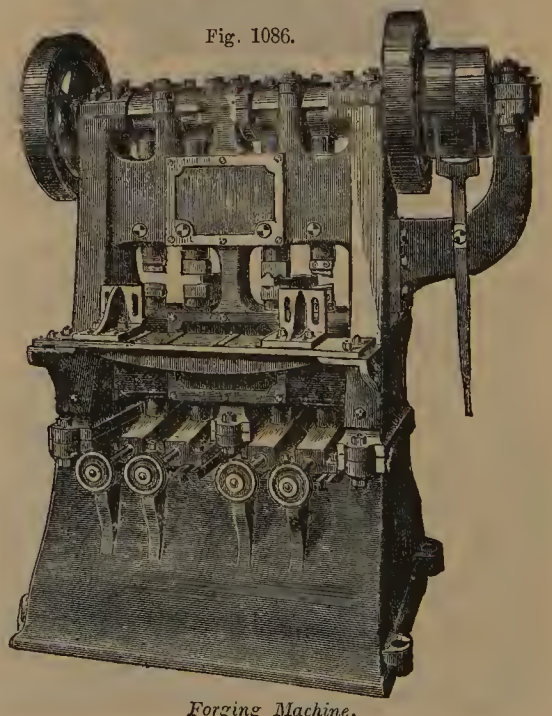


Portable Forge.

b. A blacksmith's fire-place. Figs. 1084, 1085 show English forms of portable forges. Many other forms are noticed under BLOWER; JEWELERS' FORGE; LABORATORY FORGE, etc.

Buffalo Forge . . . . * "*Iron Age*," xxii., Dec. 5, p. 19.
* "*Scientific Amer.*," xxxviii. 364.
Patterson . . . . * "*Man. & Builder*," x. 57.
Thwaites & Carbutt, Br. * "*Engineering*," xxvi. 35.
Hammer, *Longworth*, Br. * "*Engineer*," xliv. 4.
Rawlings . . . . . * "*Scientific Amer. Sup.*," 1363.
Tangye, Br. . . . . * "*Engineer*," xlii. 378.
Alker . . . . . * "*Scientific American*," xl. 166.

Fig. 1086.

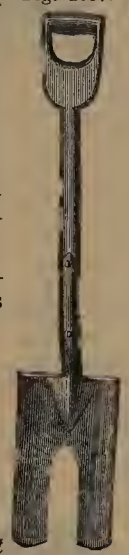


Forging Machine.

For'ging Ma-chine'. Massey's forging machiue (Br.) is intended for a class of forgings, such as spindles, bolts, studs, rollers, pins, files, and a great variety of other articles in common use.

It has four pairs of blocks or hammers, 3½″ diameter. The lower blocks can be set up or down while the machine is running. The eccentric shaft is steel, running in very large white-metal bearings. The machine can be worked from both sides, so that two or more men can use it at the same time. Speed, 750 revolutions per minute. Weight 7,000 lbs. Power required to drive, about one horse. Floor space required, 4′ 3″ by 3′ 9″. Height over all, 6′ 6″.

Fig. 1087.



See Steel Press, Fig. 5747, p. 2369, "*Mech. Dict.*" Also, paper on the "*Système Haswell*," at Vienna, by Butler, of Leeds, England. Debate by Paget, Sir Joseph Whitworth, and others. "*Scientific American Sup.*," 712.

Fork'ing Spade. A bifurcated digging tool. The tool with several tines is a *digging fork*.

Form'ing Iron. (*Forging.*) A species of swage block, used by the blacksmith in rounding rods. The grooves of various radii to suit different requirements.

Fig. 1088.

Forming Iron.

Forking Spade.

Form'ing Ma-chine'. 1. (*Sheet Metal Working.*) A machine for bending tin plate to circular form. The diameter of the circularly bent plate depends upon the relative proximity of the three rollers between which the plate passes.

Fig. 1089.

Forming Machine.

See also Stamping Press, Figs. 5543-5545, pp. 2304, 2305, "*Mech. Dict.*"

2. The forming machine, Fig. 1089, is adapted for felt, buckram, straw, tin, and what not.

See also Hat-forming Machine.

3. A machine for laying up strands into rope, Fig. 1090. It is on the same principle as Fig. 4442, p. 1981, "*Mech. Dict.*"

For'no-con-ver'tis-seur. A French name, familiar to English speaking metallurgists as the title of the Ponsard furnace for the manufacture of steel.

See article by J. Sylvain Périssé, member of the national jury in Paris, 1878, published in the "*Journal of the British Iron and Steel Institute*," and reproduced in "*Van Nostrand's Engineering Magazine*," xxi. 252.

See also Ponsard Furnace.

The *Ponsard* furnace, like the *Siemens-Martin* and others, whether applied to metallurgic or other purposes, is a gas generating furnace and has a peculiar regenerator. See Gas Generating Furnace; *Siemens'*, Figs. 1159, 1160, and *Ponsard's*, Figs. 1161, 1162, pp. 386, 387, *infra*, both of them as applied to gas works.

Forty'five De'gree El'bow. A pipe coupling equal to ⅛ bend. See Bend.

Foun'dry Fur'nace. System of *Piat*, Paris: Reverberating and blast furnaces. The furnace of sheet-iron containing the crucible is on trunnions, or can be unshipped and moved by crane or by hand to the flask. See Crucible Furnace.

* "*Scientific American Supplement*" . . . . . 2857.

Foun'dry La'dle. One for carrying molten metal from the cupola to the flasks.

See Ladle; Shanks, "*Mech. Dict.*" *et infra.*

Aikin & Drummond's mounted ladle is supported on two wheels at a point on the shank, which enables a stout boy to counterpoise and push it, holding by the crotches.

Pintsch's ladle, Fuerstenwalde, Prussia, is of wrought iron, and the iron flows from a partitioned channel riveted along the side of the kettle, and opening into the same near the bottom. This excludes floating dross.

French fouudry ladle, *Laboulaye's* "*Dictionnaire*," ii., Figs. 930, 931, 947, article "Fonderie de fer."

Foun'tain Pen. One carrying a supply of ink, fed gradually to the point of the instrument. The pens shown in Fig. 1091 have abandoned any attempt at graceful writing, being merely hollow handles with tubular points. A fine needle inside governs the flow of the ink in the Stylographic pen, — the two figures on the right. In the McKinnon pen, the tubular point is fine, and yields ink when pressure is applied.

Fig. 1091.

Fountain Pens.

Foun'tain Pump. A garden or syringing pump, for watering flowers, or applying wet poisons to the cotton worm, etc.

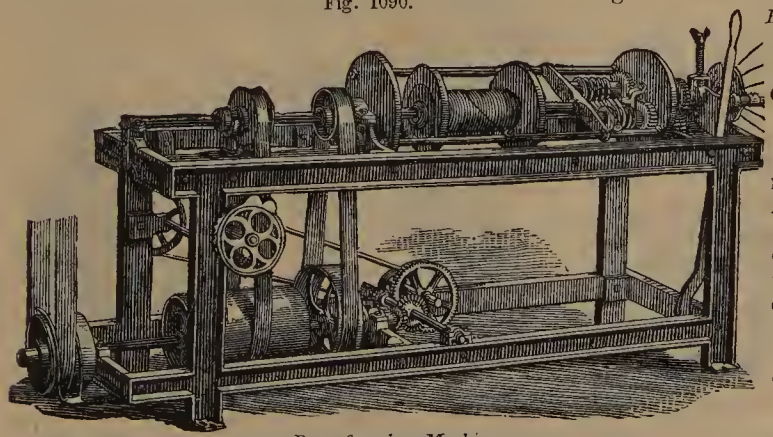
Comstock's "*Report upon Cotton Insects*," 1879,* p. 239, and Fig. 51.

See also Spraying Machine; Sprinkler; Insect Destroyer, *infra.*

Four-cyl'in-der En'gine. See the following: —

Brown, Winterthur . . * "*Engineering*," xxi. 126. 177.
Vosper, Br. . . . . * "*Engineering*," xxvii. 569.
Compound, *Watts*, *Br.* * "*Engineering*," xxvi. 118.

Fig. 1090.



Rope-forming Machine.

Four-high Mill. A rolling mill with four rollers in tier. "*Iron Age*," xxii., Dec. 5, p. 3.

Four Screw Chuck. A lathe chuck in which the object is centered by the use of four screws quadrantically disposed. See Drill Chuck, p. 276, *supra.*

Four Spindle Drill. A gang drill with four spindles.

Pratt & Whitney, * "*Thurston's Vienna Report*," ii. 224.

Four-strand'ed Splice. (*Nautical.*) A splice made in a four-stranded rope, or *four cant* rope.

Four Valve Spec'u-lum. A urethral, or other, speculum which has four expanding fingers as in several of the instances, Fig. 5360, p. 2260, "*Mech. Dict.*" Certain speculi are always referred to under their specific names, as *otoscope*, *rhinoscope*, etc. See list under SURGICAL INSTRUMENTS and SCOPE, p. 2056, "*Mech. Dict.*"

Four'-way Cock. 1. (*Railway.*) A faucet in the air-brake arrangement with two passages in it, and used for opening and closing communication between the brake cylinder reservoir, brake pipe, and triple-valve. See TRIPLE-VALVE.

2. A bath tub cock with index, "Hot," "Cold," "Waste," "Shut."

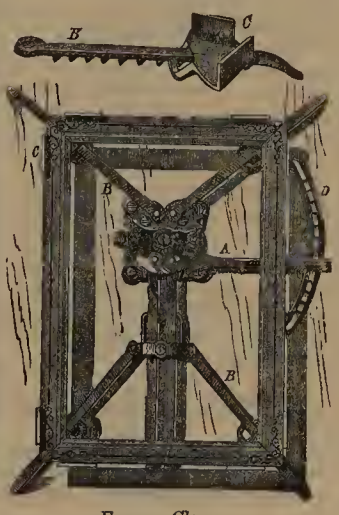
Frac'ture Ap'pa-ra'tus. (*Surgical.*) The list includes splints, bandages, swings, extension apparatus, bedsteads, etc. The distinctions are also drawn from the part affected. See SPLINT, EXTENSION APPARATUS, COUNTER EXTENSION APPARATUS, etc., in "*Mech. Dict.*"

See list under SURGICAL INSTRUMENTS AND APPARATUS, pp. 2459-2461, "*Mech. Dict.*" The following references are to *Tiemann's "Armamentarium Chirurgicum,"* Part IV.

Femur	Figs. 102, 103, 105–111.
Fracture bed . . .	Figs. 104, 158, 159, 168, 169
Patella	Figs. 112–118.
Lower leg	Figs. 119–121.
Lower maxillary . .	Fig. 122.
Clavicle	Figs. 123–127.
Lower arm.	Fig. 128.
Suspending apparatus	Figs. 102, 103, 120, 130, 140, 154, 156, 157, 174.

Frame Clamp. A device for putting picture and looking-glass frames together. To a single lever *A* moving over a rack *D*, four stretchers are connected each to one of the corner clamps *C* so as to draw them equally. The clamps *C* are adjustable on the stretchers, as seen in the detached view, according to the size of the frame.

Fig. 1092.



Frame Clamp.

Frame Drill'ing Ma-chine'. A machine, Fig. 1093, with several self-acting drilling head stocks for operating on different parts of a locomotive frame at the same time.— *Whitworth.*

Frame'less Spec'ta-cles. Those in which the nose-piece and temples are attached directly to the lenses; bows being dispensed with.

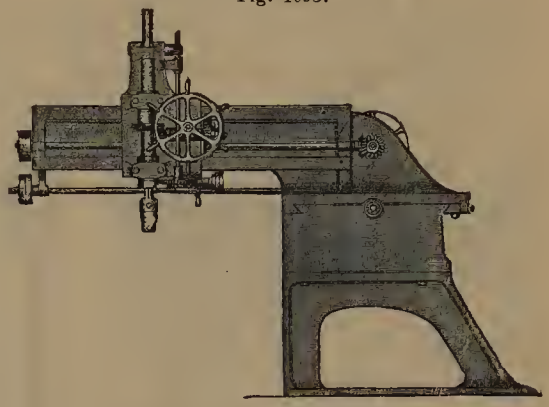
Frame Pla'ning Ma-chine'. A machine with independent self-acting cross slides and tools, for planing different parts of a locomotive frame at the same time.

Frame Slot'ting Ma-chine'. A machine for working on locomotive frames, having several self-acting head-stocks capable of being independently operated.

Frank'lin Spec'ta-cles. The lens in each bow is divided on its major axis; the upper section for *far*, and the lower for *near* observation; for distance and for reading.

Freez'ing Ap'pa-ra'tus. (*Surgical.*) See ATOMIZER; SPRAY APPARATUS, etc., Fig. 181, p. 93, "*Mech. Dict.*," and Fig. 128, p. 55, *supra*. See also ICE.

Fig. 1093.

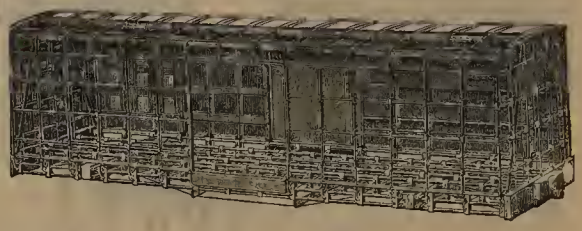


Frame Drilling Machine.

Freezing mixtures, "*Mechanical Dictionary*," p. 1167.
"*Scientific American Supplement*," 1420.

Freight Car. One for carrying freight, as distinct from passenger, express, mail, etc., cars, on the one hand, and gravel, coal, and construction cars on the other. Fig. 1094 shows a box freight car with frame made of tubular iron.

Fig. 1094.



Box Freight Car.

See the following references: —

Light	"*Sc. American Sup.*," 847.
Iron	"*Iron Age*," xxiii., Feb. 20, 7.
Metallic	"*Iron Age*," xxi., Jan. 24, p. 7; May 14, p. 7.
N. Y. Central	* "*Engineering*," xxi. 444. "*Sc. American Sup.*," 285.
Lake Shore and Mich. S. .	* "*Railroad Gazette*," xxii. 610.
Standard box, N. Y. C. . .	* "*Railroad Gazette*," viii. 119.
Freight stock car, *Chalender*	* "*Railroad Gazette*," xxii. 261.
Hoist and conveyor . . .	* "*Iron Age*," xvii., March 16, 1.

Freight Truck. A hand-truck, for moving heavy packages, known as a freight *barrow*-truck or freight *wagon* truck according to whether it has 2 or 4 wheels respectively.

Fresh'et Sig'nal. An apparatus to give an alarm upon the occurrence of a rapid rise in a stream.

Fig. 1095.

Fresnel Lamp.

Gros's freshet signal apparatus, used in the Lot, Aveyron, France, indicates automatically, by electrical means, any variations in level from a higher to a lower point. A float at the higher point communicates its upward and downward movement, by means of a battery and wire to a needle pointing on a graduated scale. When the rise is such that there is danger a bell is sounded which sets in action a number of bells in the houses of inhabitants along the banks and warns them of the coming flood.

Fres-nel' Lamp. One with a cylindrical lens formed of prismatic zones above the equatorial region.

Fres-nel' Lens. (*Optics.*) A lens consisting of a central portion of spherical sec-

tion and surrounding rings, so adapted as to direct the rays practically parallel, and prevent their loss by radiation in useless directions.

The *Fresnel* is the third in the series of the great improvements which are now universally adopted in light-houses, using the dioptric system.

Fig. 1096.

Fresnel Lens.

These three inventions are French, and are the *Argand* burner (1774), the mechanical lamp (*Carcel*), and the *Fresnel* lens (1810). The light is in the focal center of a series of lenses, which assume what may be roughly called a barrel-shape, around the burner. The equatorial portion of the series is a sort of cylindrical hoop, the vertical section of the band of glass showing such lines that the rays passing through it are diverted to a horizontal plane; the rays striking above or below the central zone are intercepted by rings of prismatic section, and are so refracted as to assume a direction parallel to those proceeding from the equatorial region of the glass envelope surrounding the burner. See DIOPTRIC LIGHT, Fig. 1657, p. 704, "*Mech. Dict.*"

Fret Saw. A jig or band saw, for bargeboard, bracket, and Sorrento work.

McChesney, Br.
* "*Engineer*," xliii. 55.
* "*Manufacturer & Builder*," xi. 220.
Rogers.
* "*Engineer*," xlvi. 134

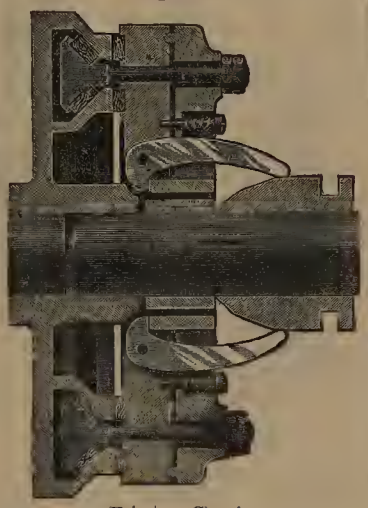
Fric'tion Brake. 1. *Prony's* brake. A form of *dynamometer*. Fig. 2102, p. 915, "*Mech. Dict.*"

Richards . . . . . "*Iron Age*," xx., Aug. 30, p. 11.

2. A measurer of the lubricity of oils. See FRICTION METER, OIL TESTER.

Fric'tion Clutch. A device by which a pulley is made fast to a shaft so as to partake of the motion of the latter; or one shaft made to partake of the motion of another.

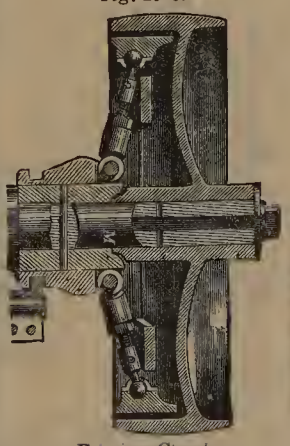
Fig. 1097.



Friction Clutch.

Fig. 1097 shows Frisbie's clutch, which fastens by the hub. The cone is moved by the shipper expanding the levers and so locking the parts together that the frictional adherence is equal to the duty of transmitting the motion of one part to the other.

Fig. 1098.



Friction Clutch.

Mason's clutch, Fig. 1098, operates by expanding the friction segments against the inner rim of the wheel: a longitudinal sliding movement of the sleeve towards the pulley effects this; and *vice versa*.

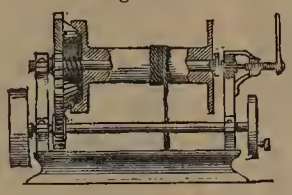
A Belgian friction clutch operates by contact of two disks with interlocking face grooves.

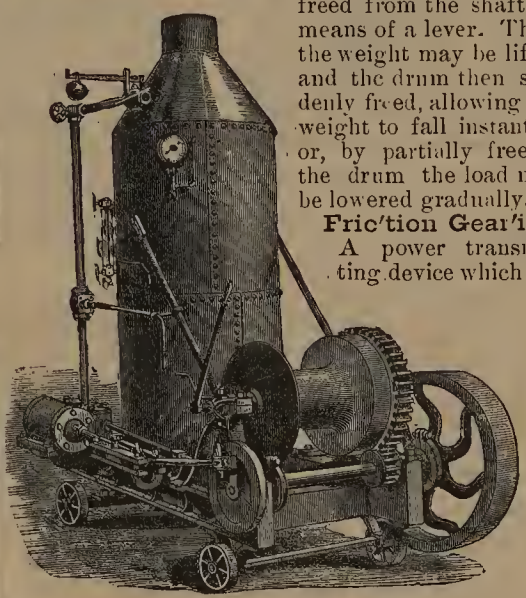
See the following: —

Addyman . . . . . * "*Engineer*," xlix. 268.
Am. Clutch Co. . . . . * "*Iron Age*," xvii., June 8, p 5.
Coupling, *Bagshaw*, Br. . * "*Engineering*," xxx. 100.
Belgian . . . . . * "*Sc. American*," xxxvi. 147.
Pfleiderer, Br. . . . . * "*Engineering*," xxvii. 243.
Drum, *Mundy* . . . . * "*Scientific Amer.*," xxxvi. 338.
Pulley, *Bean* . . . . . * "*Eng. & Min. Jour.*," xxi. 250.
Brown . . . . . * "*Mech. Dict.*," Fig 2103, p. 916; Fig. 1351, p. 578.
"Giant" . . . . . * "*American Miller*," viii. 225.

Fric'tion Drum Hoist. A hoisting engine operated by friction from a constantly moving shaft. Fig. 1099 shows Mundy's friction drum hoisting machine, used for pile drivers and derricks. It is a portable engine and hoist, but the drum can be locked to or freed from the shaft by means of a lever. Thus, the weight may be lifted and the drum then suddenly freed, allowing the weight to fall instantly; or, by partially freeing the drum the load may be lowered gradually.

Fig. 1099.





Friction Drum Hoist.

Fric'tion Gear'ing. A power transmitting device which depends upon the frictional adherence of the allied parts.

In Van Haagen's, the wheels have square grooves in their peripheries which interlock so as to form intimate bearing surfaces.

Fig. 1100.

Friction Gearing.

See also Fig. 1601, p. 680, "*Mech. Dict.*," where friction gear is shown as working the feed of a sawmill.

French * Art. "*Engrenage*," *Laboulaye's* "*Dict.*," iv., Figs. 3526, 3527.
Round belt in multi-grooved pulleys.
* "*Newton's Journal*," 157, N. S., vi. 163.
Paper by Wicklin.
* *Cooper's* "*Belting*," 288.
Pump driver, *Hind*, Br. . . . . * "*Engineering*," xxii. 118.
Gear . . . . . * "*Engineering*," xxiii. 147.

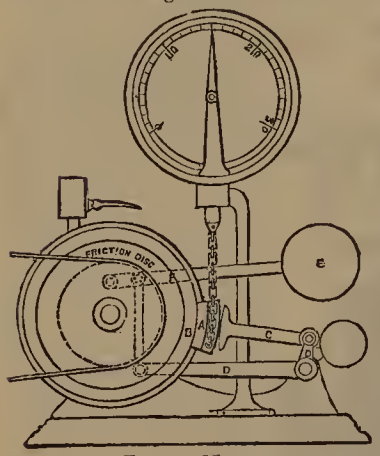
Fric'tion Heat'er. A device for obtaining heat from friction. A cylinder of water has an iron end plate, against which revolves a disk, and the friction of the two generates heat, which is communicated to the water. The latter is conducted in any usual way to different parts of the house. — *Prof. Wills.*

Fric'tion Ma-chine'. An electric machine, generating electricity by contact with amalgamated silk.

Fric'tion Me'ter. A test for lubricators.

The block *A* is pressed against the periphery of the wheel by an arm *C*, which is a segment of a roller, balanced and pivoted on the short arm of the bell crank *D D*, the long end of which is connected by a link to the lever *F*, which has a weight, *E*, on the outer end of it; and a chain connects the friction block *A* to a spring balance. The wheel is to be made to turn to the right at any desired velocity of circumference, by means of a band from a lathe, or otherwise, when the friction of the wheel on the friction block will tend to carry the latter along with the former; but it is prevented from doing so by the chain to the spring balance, which indicates the amount of the tendency of the block to move along the wheel, or, in other words, the total amount of friction on the rubbing surface. — *Napier.*

Fig. 1101.



Friction Meter.

See also Oil Tester; Lubricant Tester.

Fric'tion Rol'ler Drop. An arrangement for working a drop hammer. Hotchkiss & Stiles. See Fig. 2104, Friction Hammer, p. 916, "*Mech. Dict.*"

Fric'tion Wheel. One operating by the friction of its surface; as in some cases a large buff-covered wheel driving a number of spindles by frictional contact.

See some notices in Cooper's "*Belting*," 206.

See also Friction Gear; Friction Clutch, *supra;* and Friction Wheel; Friction Hammer, "*Mech. Dict.*"

Friez'ing Cut'ter. A rotative bit for making friezes, moldings, etc.

Friez'ing Ma-chine'. An edge-molding machine. The vertical cutter projects up through the table of the machine and works molding on the stuff fed up to it. It is called a friezing machine, as it is adapted to making frieze moldings for ceilings. See Fig. 3200, p. 1468, "*Mech. Dict.*"

Frit. (*Ceramics.*) The material for glaze of pottery.

A frit for stoneware glaze: —

Ground feldspar	25
Ground quartz or flint	25
Sal soda	25
Clay	15
Boracic acid	10
	100

After being fused in a *frit furnace*, it is run into a stone vat, cooled, broken into fragments, and ground into a fine paste with water in a *frit mill*. The result is a fine slip to which white lead as a fuse and cobalt as corrective of yellow are added.

The porous biscuit is dipped in this slip.

Frit Fur'nace. (*Ceramics.*) A reverberating furnace in which frit for glaze is fused.

Frit Mill. (*Ceramics.*) A tub mill, with buhr-stones in which the material for glaze (see Frit) is ground into an impalpable slip.

Fromm'hold Cell. A single liquid battery having a platinized leaden plate clamped between two zinc plates with intermediate insulation. Immersed in dilute sulphuric acid.

See Slater & Watson's English Patent, 1852.

Front Cyl'in-der Head. That head which is opposite to the piston. The *back end* has the stuffing box for the piston-rod.

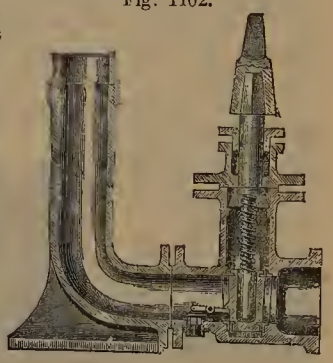
Front Sight. As distinguished from rear or hind-sight. The sight on a gun near the muzzle. It may be *globe, aperture, open,* or *pin.* See Sight.

Frost Cog. A toe or projection on a horse shoe to keep the animal from slipping on ice or frozen ground.

Frost'ing. (*Fine Art Metal-working.*) Making a dead surface on the metal so as to give a sombre tint; or it may be done over a part of the surface so as to throw the bright portions into greater prominence and so obtain variety.

Frost Valve. A valve which opens to allow water to escape from the portion of the pipe or pump where it is liable to be frozen. Stone's frost valve is so arranged that the act of screwing down the hydrant to close it opens the small frost valve and allows the hydrant to free itself of water.

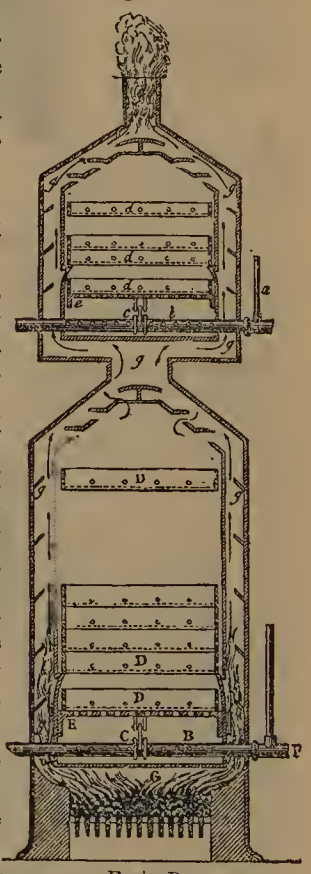
Fig. 1102.



Frost Valve.

Fruit Dry'er. The Reynolds fruit dryer is a shaft in which the shelves are horizontal. The trays of fresh fruit are put in at the bottom, the pile of trays being lifted temporarily for that purpose by means of the lifting bottom *D*, crank shaft *C B*, and handle *A*. From 12 to 20 trays are used; the heat is about 200° Fah., and the fruit in the upper trays is bathed in the steam and aroma of the fresher fruit more immediately exposed to the fire.

Fig. 1103.



Fruit Dryer

The point of delicacy in management consists in prompt drying after cutting to avoid discoloration.

It is a good plan to subject the freshly cut fruit to the fumes of sulphurous acid gas, obtained by burning sulphur in a chamber or cask in which the cut fruit is exposed. This is a plan used from time immemorial to prevent acetic fermentation in wine and cider casks, and also to delay the vinous fermentation with wine or cider. The trays with the finished article are removed from the top one at a time. In Fig. 1103 the apparatus has a supplementary chamber above for finishing the operation when a tray of doubtful completion has been removed. Gold medal at Paris, 1878.

In a California machine the trays are similarly disposed but hung on a carrier-chain. The *Williams* machine has a high tower with a furnace at the bottom, and endless chains with wire trays which revolve slowly, causing the fruit last put in to pass first through the hottest part. Bleaching with sulphur is used. The *Alden* process is somewhat similar.

The *Jones* dryer (Farquhar, York, Pa.) is made in three forms, *horizontal*, *portable*, *double-flue upright*.

In the *horizontal* fruit dryer a current of heated air is drawn through the two horizontal fruit chambers by an exhaust fan. The chambers are one above the other with side doors for the introduction and removal of fruit trays.

In the *portable* the trays are in vertical columns in a sheet iron box at bottom of which is a furnace. The trays are put in at bottom, the pile being raised for that purpose, and the trays with finished fruit removed from the top. The trays are covered with netting.

The *double-flue* is larger, parts are duplicated, and it occupies the height of two stories, or a cellar and one story

Dietz California fruit dryer has a number of sloping chambers one above another. The fruit in wire trays is put in at front and pushed back from time to time as new trays are ready, and the dried fruit removed at the back. The fire-heat circulates in all the chambers, the fresh fruit being exposed to the hottest part.

Alden . . . . . * "*Mining and Sc. Press*," xxxviii. 267.
Boswell . . . . . * "*Mining and Sc. Press*," xxxvii. 281; xxxviii. 268.
Blower . . . . . * "*Mining and Sc. Press*," xxxvi. 249.
Harris . . . . . * "*Mining and Sc. Press*," xxxvi. 289.
Mumbrue . . . . * "*Scientific American*," xlii. 162.
On drying fruit . . * "*Scientific American*," xl. 146.
* "*Scientific American Sup.*," 2103.
"*Scribner's Magazine*," June, 1878.

Fruit Pit'ter. A device to remove the stones of fruit, such as peaches and plums.

Hatch's pitter splits the fruit and removes the pit. Each half of the tubular opening carries its own section of the knife, and the two are hinged together so as to expand to any necessary size.

Fig. 1104.

Fruit Pitter.

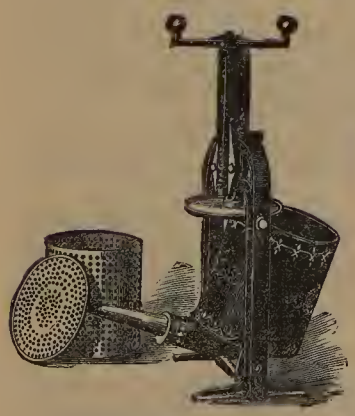
See also CHERRY, PEACH, etc. "*Mech. Dict.*"

Fruit pitter, *Lillie* * "*Min. & Sc. Press*," xxxiv. 289.

Fruit Press. Cider, wine, and oil presses are considered under their own captions. Figs. 1105, 1106 show domestic presses for small fruit, and useful also for stuffing sausages. See also DRAW-UP PRESS, Fig. 872, p. 274, *supra*, and list under PRESSES, *infra*.

Fruit (or Seed) Sep'a-ra'tor. A machine which separates and grades cranberries, beans, and seed.

Fig. 1105.



Fruit Press (Open).

Fig. 1106.

Fruit Press (Closed).

The detachable feeder runs on top, and has a trembling motion, combined (optionally) with lateral motion. The sieves are lettered for kinds of grains and seeds, and numbered for places where used. — *Brown.*

Fruit Sli'cer. An open-bottomed box with a follower, to contain fruit, and slipped back and forth in grooves over a knife fixed like that of a slaw-cutter beneath. — *Wharry.*

Fu'el. The table gives the comparative evaporative value of fuels.

The feed water being 212° Fah. when it enters the boiler, the following results were obtained from the consumption of 1 pound of the undermentioned fuels. The first eight give the average of many samples tested by Messrs. Delabeche and Playfair: —

	Specific Gravity.	Pounds of Water Evaporated.		Compar. Values.
Welsh coal	1.315	9.05		1.000
Newcastle coal . . .	1.256	8.01		0.885
Derby and York coal .	1.292	7.58		0.837
Lancashire coal . . .	1.273	7.94	By trial	0.877
Scotch coal	1.260	7.70		0.851
British average . . .	1.290	8.13		0.898
Irish anthracite . . .	1.590	9.85		1.088
Patent fuels	1.167	9.20		1.016
French coal (average) .	1.310	8.00		0.884
Liguites (average) . .	1.198	6.66		0.736
Dried peat	1.300	4.52		0.500
Coke (average) . . .	0.750	9.00	Approx.	0.995
Oak	0.930	4.52		0.500
Pine	0.660	2.50		0.276

Wood for Fuel as compared with Coal. — It is safe to assume that 2½ lbs. of dry wood is equal to 1 lb., average quality, of soft coal, and that the fuel value of the same *weight* of different woods is very nearly the same, — that is, a pound of hickory is worth no more for fuel than a pound of pine, assuming both to be dry. If the value be measured by the *weight*, it is important that the wood be dry, as each 10 per cent. of water or moisture in the wood will detract about 12 per cent. from its value as a fuel.

The weight of one cord of different woods (air dried) will be found to be about as follows, for an honest cord of split wood: —

Hickory, or hard maple	4,500 lbs.
White oak	3,850 lbs.
Beech, red oak, and black oak	3,250 lbs.
Poplar (white-wood), chestnut, and elm .	2,350 lbs.
The average of pine	2,000 lbs.

The fuel value as compared with coal is about as follows: —

1 cord air-dried hickory or hard maple equal to	2,000 lbs. coal.
1 cord air-dried white oak equal to . .	1,725 lbs. coal.
1 cord air-dried beech, red oak, or black oak equal to	1,450 lbs. coal.
1 cord air-dried poplar, chestnut, or elm equal to	1,050 lbs. coal.
1 cord air-dried average of pine wood equal to	925 lbs. coal.

Buckeye Engine Co.

Fu'el, Ar'ti-fi'cial.

The artificial fuel of Loiseau is made under Patents 78,982, 104,471, 147,663–147,666, 167,913, 167,914.

1868 Patent: coal dust, clay, saleratus, and shellac made into a paste, formed in molds and dried.

1870 Patent: a protecting covering.

1874 Patents: 1. a mixing apparatus.

2. Clay is dried, reduced to powder, mixed with the coal dust, moistened with milk of lime, kneaded, molded into lumps, the lumps waterproofed with a resinous material.

3. Mixing and molding apparatus. The coal dust with clay and lime-water is placed in a pug-mill, delivered to compressing rollers in a broad sheet, and the compressed lump falls upon a conveying apron.

4. A machine for coating the artificial fuel with a waterproofing composition. An apron dipping into a tank.

5. Molding. The balls are formed by two hemispheres, which are fastened together by bolts. Wire cloth aprons are confined between the hemispheres.

1875 Patents: 1. Mixing and molding. Stirrer blades on revolving shafts feed the composition to the molding cylinders.

2. Coal waste mixed with pulverized clay and diluted rye and lime paste.

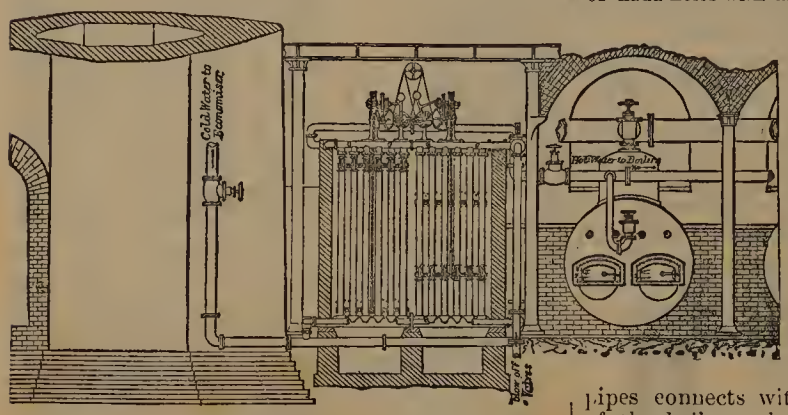
See the following references: —

Dixon . . . . . "*Scientific Amer. Sup.*," 7.
In France, etc. . . . . "*Engineering*," xxvi. 379.
Paper on, *Loiseau* . . . "*Man. & B.*," x. 178, *202.
Loiseau . . . . . "*Iron Age*," xvii., Ap. 20, p. 7.
Loiseau . . . . . "*Report Juries of Group I., Paris Ex. Rep.*," 1876, p. 55.
Loiseau . . . . . "*Van Nost.'s Mag.*," xix. 544.

Loiseau . . . . . "*Scientific Am.*," xxxviii. 339.
Compressed . . . . . "*Scientific Am. Sup.*," 2469.
"Amianthine coal."
Rocker, Fr. . . . . "*Scientific Am.*," xxxix. 149.
Fuel, gas, *Strong* . . . "*Scientific Am.*," xxxix. 273.
Fuels, liquid.
Paper by Aydon . . . "*Scientific Am. Sup.*," 1890.
Tan-bark fuel, Fr. . . *"*"*Scientific Am. Sup.*," 3895.
Press, *Grant*, Br. . . "*Iron Age*," xxii., July 11, p. 20.
See also BRIQUETTE. See *Siemens'* "*Fuel.*"

Fu'el E-con'o-mi-zer. An invention of Twibill, of Manchester, England. A feed-water heater by the waste heat escaping at the chimney.

Fig. 1107.

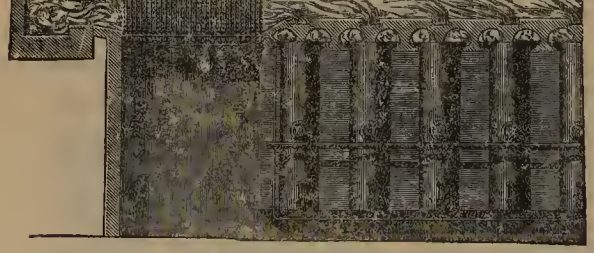


Fuel Economizer.

Statement: "There are two sources of waste in all steam boilers which may in a measure be made to neutralize each other. The gases going to the chimney carry off on an average, according to good authority, 31 per cent. of the fuel, and in the most economical boiler this cannot be reduced below 12 per cent. The feed-water, on the other hand, has to be heated from the normal temperature to that of the steam before evaporation can commence, and this generally at the expense of the fuel which should be utilized in making steam. This temperature at 75 lbs. pressure is 320°, and if we take 60° as the average temperature of feed, we have 260 units of heat per pound, which, as it takes 1151 units to evaporate a pound from 60°, represents a loss of 22.5 per cent. of fuel. All of this heat, therefore, which can be imparted to the feed-water from the waste heat in the escaping gases is just so much saved."

The *economizer* is placed parallel to the battery of boilers, between them and the chimney shaft. It consists of 36 transverse rows of vertical pipes, there being 12 pipes in each row, connected at top and bottom by transverse horizontal pipes. The pipes are of cast iron and cylindrical, the lower end turned slightly conical and pressed into a socket in the transverse pipe beneath, in which it is planted. The transverse pipes communicate at their ends with transverse longitudinal pipes, and to these the inlet and outlet for the feed-

Fig. 1108.



Twibill's Fuel Economizer.

water are attached, the arrangement being such that the cold water admitted at the bottom circulates upward, exposed to the heat of the pipes, which are surrounded by the flame and the heated escaping gases passing from the furnace to the chimney. The water is led off to the boilers at a heat of 280° Fah.

A scraper is provided for each pipe to remove soot from the exterior to keep the heat-conducting character of the iron intact. These are coupled in groups, and kept continually moving up and down by means of gearing, pulleys, and scraper chains.

The *Babcock & Wilcox* fuel economizer holds a similar place between the furnace and chimney. The tubes are connected at top and bottom with horizontal tubes, the lower row of which are connected to a mud-drum, and the upper row are connected together at the end diagonally opposite to the mud-drum. The feed-water enters at one end of the mud-drum and passes out at the opposite end of the upper connecting pipe. The hotter gases, filling the upper portion of the chamber, come in contact with the water at its highest temperature, so that it is possible to heat the latter very nearly to the temperature of the escaping gases before it flows to the boiler.

Ample provision is made for cleaning the interior of the vertical and horizontal tubes, and the mud-drums, by means of hand-holes with metallic joints opposite the ends of each tube. This is important, as in most hard waters sediment will form in the economizer more readily than in the boiler.

By means of a direct flue to chimney, the economizer may be cleaned without stopping the boilers.

Mechanical scrapers worked from above are provided for removing deposits of soot from the exterior of the tubes, the soot falling into a chamber below, from which it may be removed at convenience.

The Miller economizer consists of rows of tubes lining the sides of the fire chamber beneath, and partially alongside of the boiler. The system of pipes connects with the lower and upper portions of the boiler and causes a circulation, as well as adding a large amount of heating surface.

Mason & Alcock, Br. * "*Engineering*," xxix. 261.
Wavish, Br. . . . * "*Engineer*," xlviii. 451.
Babcock & Wilcox . * "*Eng. & Min. Journal*," xxviii. 109.
* "*Manufacturer and Builder*," xi. 1.

See also list of references under FEED WATER HEATER, pp. 328-330, *supra*. See also HOT-BLAST APPARATUS, *infra*, for a device of somewhat similar construction but for the purpose of heating air for metallurgic furnaces. See also REGENERATOR and GAS-GENERATING FURNACE, for other methods of utilizing escaping furnace heat.

Fuel Feed'ing Ap'pa-ra'tus. In Jucke's device the fuel is placed on an endless chain carried by two rollers and driven by the engine. This endless chain forms the fire-bars, and moves so slowly that the fresh fuel placed upon it at the furnace mouth is gradually carried backward, consumed, and delivered at the rear in the form of ashes and clinkers. The rollers and chain are carried on a sort of trolly, so that the whole can be drawn out when necessary, and the rate of motion is made adjustable to regulate the supply of fuel.

See also STOKER, MECHANICAL.

Ful'gu-ra-ta. (*Electricity.*) A spectro-electric tube in which the decomposition of a liquid by the passage of an electric spark is observed.

In that of M. Duboscq, the vertical tube has a pair of platinum wires; the upper one extends nearly to the lower end, and the lower one is surrounded with a short conical glass tube, which by capillary attraction contiuually supplies the fluid under examiuatiou which covers the poiut of the lower electrode. "*Telegraphic Journal*," * iv. 285.

Full Cir'cle. A form of FIFTH WHEEL, *q. v.*

Ful'ler Bat'te-ry. (*Electricity.*) One having a zinc element, which is permanently amalgamated by placing its enlarged base in mercury in the porous cell, which is otherwise filled with water. The carbon plate is placed in the outer vessel in a solution of sulphuric acid and bichromate of potassium.

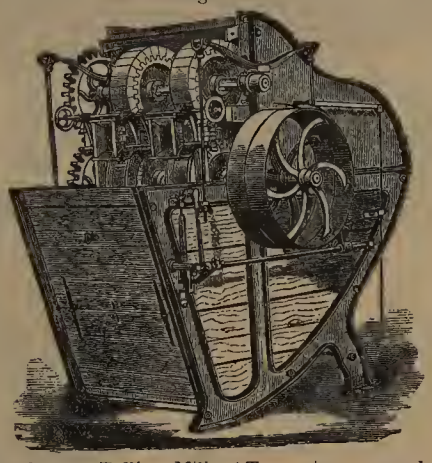
The thin portion of zinc is covered with wax, paraffine, caoutchouc, or the like.

"*Telegraphic Journal*" . . . . . * v. 9, * 53.
Niaudet, American translation . . . 218.
"*English Mechanic*" . . . . . * xxiii. 321.
"*Scientific American Sup.*" . . . . . * 628, * 1127.

Ful'ling Mill. 1. The old fulling mills were generally of wood, and the necessity for weight gave rise to their being of enormous size. The beating mill, which the nearest resembles the ancient tramping, — practiced in Asia with camel's hair for thousands of years past, — is shown in Figs. 2125, 2126, p. 923, "*Mech. Dict.*" The roller mill, which is more compact, is shown in Figs. 2127, 2128, *Ibid.*; but a still more improved form is the Rodney Hunt, shown in Fig. 1109.

In this mill, the shape of the box answers to the requirements of the work, to avoid useless quantity of suds. The

Fig. 1109.



Rotary Fulling Mill. (*Top casing removed.*)

frame is of iron, and casing of hard pine. The main squeeze rolls have cast-iron shafts covered with wood, the fiber of the wood being presented endwise outward. The bottom rolls have brass flanges between which the top rolls run. The rolls are geared, and pressure is obtained by elliptic springs. All the inside working surfaces are of wood or brass, to avoid staining the goods. By certain attachments the fuller has control of the goods, felting and stretching lengthwise, or felting the width as he may desire. An automatic stop-motion stops the mill in case of the "knotting up" of the goods.

Baldwin . . . . * "*Scientific American*," xxxviii. 38.
Benoît, Fr. . . . * *Laboulaye's* "*Dictionnaire*," ii., article "*Laine*," Figs. 1328, *et seq.*, ed. 1877.

2. A machine in which wool hats are felted; an operation equivalent to the *sizing* formerly done at the battery.

The hat body having been *formed* by a fleece of wool from the carding machine wound upon the cone, and thence removed and given a certain amount of consistence known as *hardening* (see HAT-HARDENING MACHINE), is then to be felted or fulled to give it strength, an operation which compacts the fibers and makes the cone much smaller.

The principle of felting is probably sufficiently well understood, and need not be explained here. See pp. 833, 834, "*Mech. Dict.*"

The precursor of the fulling mill was a machine invented by James S. Taylor, of Danbury, Conn., and patented May 3, 1853, as a hat-shrinking machine.

It had four rollers set with their axes in relatively angular position, which caused a roll of hats placed between them to travel slowly along while turning around between the rollers. Two of the rollers had also a vibratory motion, and the effect was a rubbing pressure, and an advancing motion. An ingenious device, and useful in its day.

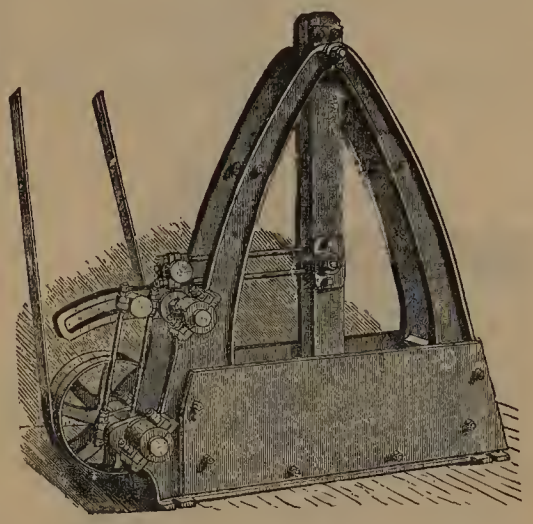
The first successful fulling mill was used in the factory of the "Seamless Clothing Manufacturing Company," of Matteawan, N. Y., about 1860, at which time the company commenced the manufacture of wool hats; and it may be remarked that the use of the fulling mill is yet principally confined to the wool hat factories, the sizing of fur hats being almost wholly done by hand on the battery.

Various styles of fulling mills are now used.

Fig. 1110 shows a mill called a *pusher*, which is used to start the hats — to follow the language of the factory — when they leave the hardening machine. The heater is driven by a bell crank, which receives motion from a crank shaft by means of a connecting rod, which is adjustable in a curved slot in the bell crank to vary the stroke of the beater.

Sometimes one beater is used, but generally two beaters acting in opposite directions, and placed side by side in the

Fig. 1110.



Crank Mill for Fulling Wool Hat Bodies.

same fulling bed, and consequently acting upon two batches of hats in the respective ends of the bed.

To finish the hat body another kind of fulling mill is used, having *fulling stocks*.

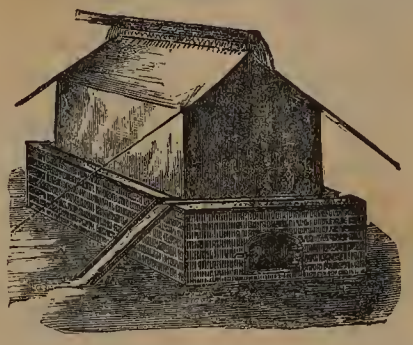
Four cast-iron frames are bolted to a solid foundation; these form the bearings for the beater shafts, and contain the fulling beds. A driving shaft operates two large gear-wheels, to which the lifting toes which actuate the beaters are attached. Two beaters operate in each bed, and the hat bodies placed in a body in each bed, slowly turning by the successive blows, are gradually fulled to a suitable size.

In some cases acidulated water is used to facilitate the fulling of the hat bodies, but in most cases fuller's soap is employed.

Full Way Valve. A pipe valve which lifts entirely out of the current. Also called a *clear-way* valve.

Fume Con-den'ser. An arrangement for condensing heated vapors and fumes, arsenic, zinc,

Fig. 1111.



Fume Condenser.

mercury, etc. See CONDENSER, "*Mech. Dict.*," *et supra*.

That shown in Fig. 1111 has canvas roof and sides flooded with water.

Fu'nis Clamp. (*Surgical.*) A clamp with two steel plates and catch for compressing the umbilical cord.

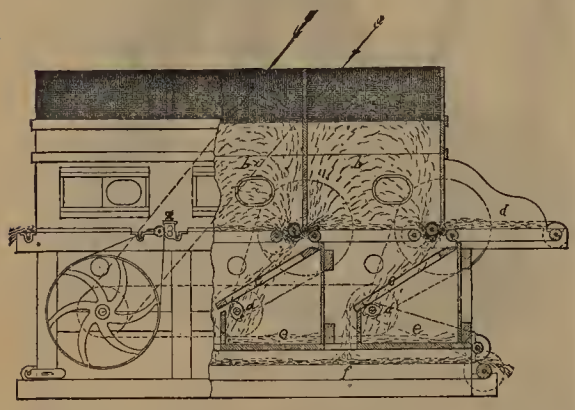
Fun'nel Box. (*Mining.*) An apparatus for collecting slimes from water. *Spitzkasten.* It is a row of square funnels increasing in size and depth, the slime-carrying water passing from one funnel box to another, the increasing capacity of each decreasing the rate of movement of the water, and thereby depositing in the successive boxes solid matter of increasing fineness.

"*Mining & Scientific Press*" . . . . . * xxxiv. 145.

Fur Blow'ing Ma-chine'. A machine to loosen out fur and remove hair and other impurities. The invention of William B. Rotch.

A number of pickers are made to operate upon the fur, which is fed into the machine by a feed upon *A*. The fur is presented to the rapidly revolving picker by two small feed

Fig. 1112.



Rotch's Fur Blowing Machine.

rollers which take the fur from the feed apron. The fur being held by the rollers is combed out, and the lighter portion is thrown by the picker into the upper chamber *B*, while the heavier part falls upon a screen *c*, which, being shaken by double cams on the shaft *d*, causes the hair and other small particles to collect in the box *e*, while the larger pieces fall upon an endless apron and are carried back to be operated upon a second or a third time until all the fur is removed.

The chamber *b* is covered with a wire cloth to allow the fine dust to escape with the current of air which is created by the rapid motion of the picker, and which carries the lighter portions of fur into the chamber, where it is deposited upon a second endless fur apron, passed by a second pair of feed rolls to the next picker, where the same operation is repeated, and so on, until, the fur having passed from 3 to 6 separate pickers, is delivered in an even *bat* ready to be used in the forming machine. See HAT-FORMING MACHINE.

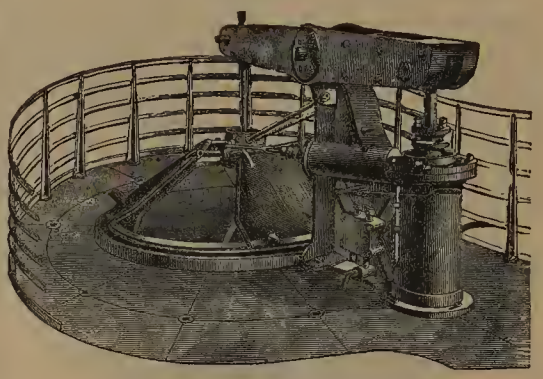
Fur'nace. See the following: —

Air furnace.	Mercury furnace.
Blast-furnace.	Open hearth furnace.
Blomary.	Ore furnace.
Blow-pipe furnace.	Osmium crucible.
Calcining furnace.	Pattinson's pots.
Carbonizing furnace.	Petroleum furnace.
Catalan forge.	Ponsard furnace.
Cementation furnace.	Puddling furnace.
Coke furnace.	Reducing furnace.
Coke oven.	Refinery.
Copper furnace.	Regenerator furnace.
Corsican furnace.	Reverberatory.
Crucible.	Roasting furnace.
Crucible furnace.	Roasting hearth.
Cupellation furnace.	Shaft furnace.
Decomposing furnace.	Siemens' furnace.
Forno-convertisseur.	Siemens-Martin furnace.
Foundry furnace.	Smelting furnace.
Gas furnace.	Steel furnace.
Gas-generating furnace.	Tempering furnace.
Hot blast oven.	Terrace furnace.
Hot blast stove.	Turf furnace.
Ladle furnace.	Turning furnace.
Lead furnace.	Wind furnace.

Fur'nace Char'ger. The Weimer furnace-charger consists of an inverted cone placed over the hopper, and doors in the cone opening to admit the ore, flux, and fuel. These doors slide on hinges secured to a revolving ring on top of the cone. Near the tunnel head is a post on which a beam vibrates; the bell inside the tunnel-head is hung to one end, and a piston is suspended from the other and moves in the vertical cylinder. The horizontal cylinder moves the ring to which the sliding doors are hung.

Fur'nace Char'ging Bar'row. See CHARGING BARROW. Fig. 600, p. 191, *supra.*

Fig. 1113.



Weimer's Furnace Charger.

Fur'nace-char'ging Scales. A scale with several beams and poises so as to fill into a barrow separate quantities by weight of the ore, fuel, and flux which go to make a charge. This allows the proportional quantities to be collected in the barrow instead of obliging them to be separately emptied into the furnace. The principle is the same as the CREAMERY SCALES, which see.

Fig. 1115.

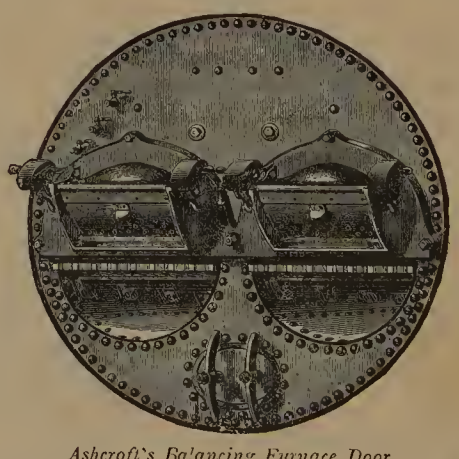
Furnace Door. (*Section.*)

Fur'nace Door. The fuel opening in front of a furnace. Contrivances have been introduced for causing water to circulate through the hinges and doors to moderate the extreme heat of the engine-room.

Asheroft's balancing furnace doors are shown in Figs. 1114, 1115, in perspective and section.

Fur'nace Feed'er. Methods of feeding furnaces automatically, and also means for avoiding

Fig. 1114.

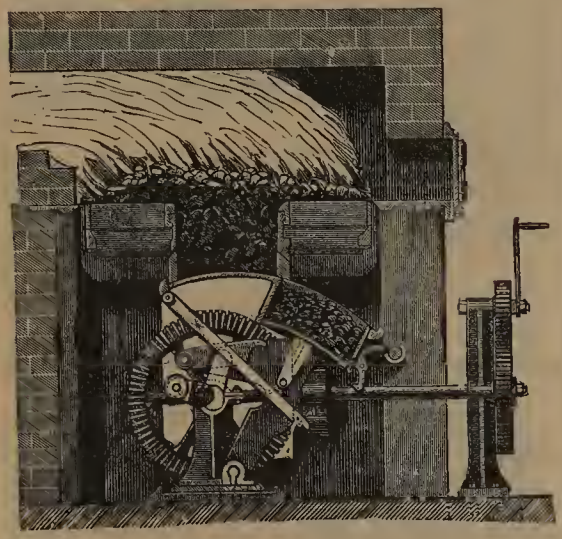


Ashcroft's Balancing Furnace Door.

the wasteful production of smoke, are described on pp. 2224–2226, "*Mech. Dict.*" Base burning, bottom feeding, secondary consumption, the dead-plate system, the revolving furnace, and steam injection, are there described. See also list of FURNACES, "*Mech. Dict.*," *et supra.*

Fig. 1116 shows Frisbie's bottom feeding furnace, in which the coal is fed from beneath; being filled into a box while in the position shown in the figure, the wheel is subsequently revolved, bringing the box into position immediately beneath the furnace when the piston in the bottom of the box is raised and the coal expelled, taking its place as the lower

Fig. 1116.

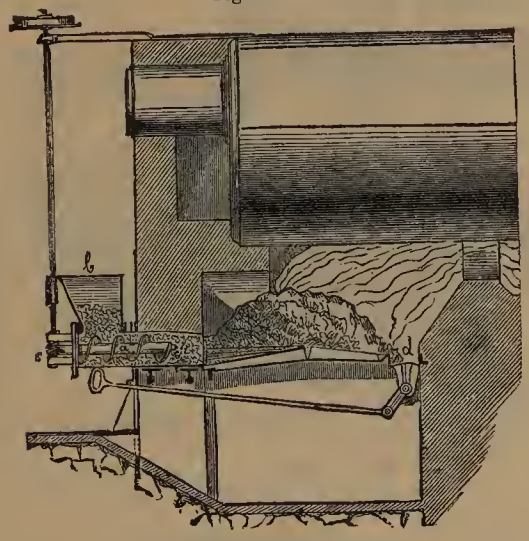


Bottom-feeding Furnace.

stratum of the fuel. A plate on the feed wheel holds up the coal when the box is again brought forward.

Fig. 1117 shows the Schultz furnace feeder. The coal is

Fig. 1117.



Dead-plate Automatic Feeder.

placed in a hopper and fed by a continuously moving screw conveyor on to the dead plate in the furnace where it is first converted into coke, the gas escaping through the incandescent fuel.

See also GAS AND COKE FURNACE.

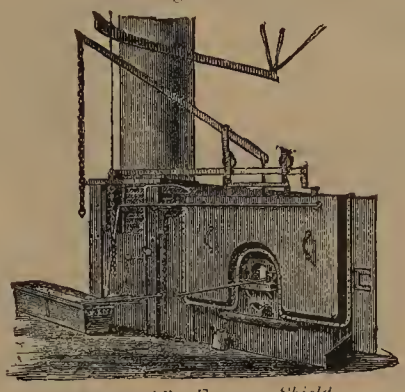
Sec: *Butcher* . . * "*Engineering*," xxv. 79, 118, 177, 213, 273.
Frisbie . . . . . * "*Engineering*," xxi. 244,
* "*Scientific American*," xxxv. 358.
McDougall, Br. . . * "*Engineer*," xliv. 262.
Schultz, Ger. . . * "*Scientific American Sup.*," 2523.
Helix, *Smith*, Br. . * "*Engineering*," xxv. 514.
* "*Scientific American Sup.*," 2193.
* "*Iron Age*," xxiii., April 17, p. 1.
Grate, *Hunter*, Br. . * "*Engineering*," xlvii. 408.
Hoist and drop, *Lonsdale*, Br.
* "*Engineering*," xxii. 497, 549.

The "helix" furnace of Smith (Br.) has a long screw conveyor which removes coal from a hopper and has subsidiary screws, one for each furnace, which continuously bring their portions of coal and deposit it in the lower stratum of fuel.

Fur'nace Scales. See FURNACE-CHARGING SCALE.

Fur'nace Shield. A heavy iron door lowered in front of a puddling furnace to shield the men from the intense radiated heat.

Fig. 1118.



McDonald's Furnace Shield.

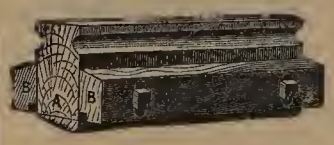
Fur'nace Slag Glass. (*Glass.*) See SLAG GLASS.

Fur'ni-ture Plush. (*Fabric.*) Also known as Utrecht velvet. A fabric with a mohair weft in the commoner qualities, but, in the best, of mohair entirely, the warps being cut in the same manner as the silk warps in velvet. See MOHAIR.

Fur'row Dres'sing Ma-chine'. A machine for cracking and dressing the furrows of millstones. See MILLSTONE DRESSING MACHINE.

Fur'row Gage'-staff. An instrument for gaging the furrows in millstones. The middle bar has a face the shape of the bottom of the furrow, and the side pieces *B B* are adjustable for the required depth of furrow and are set by bolts. In using, the face of the portion *A* is painted, so as to indicate when it touches any protruding point in the furrow. — *Taft.*

Fig. 1119.



Furrow Gage-staff.

Fig. 1120.

Furrow Rubber.

Fur'row Rub'ber. An emery tool for dressing out the furrows of millstones.

Fur'row-ing Ma-chine'. A machine for making or dressing the furrows of millstones. See MILLSTONE DRESSER.

Fu-run'cule Knife. (*Surgical.*) An instrument with a small triangular lateral blade on its end for lancing boils in the meatus auditorius.

Fuse. An exploder, time or percussion, applied to shells or other explosive charges. "*Mech. Dict.*," Fig. 2132, p. 928.

Official trials of fuses, "*Ordnance Report*," 1878, Appendix S, 2, p. 399, *et seq.*

Hotchkiss, percussion fuse . . . Plate I., p. 399.
Schenckl, percussion fuse . . . Plate II., p. 400.
Absterdam, percussion fuse . . Plate III., p. 401.
Eggo, percussion fuse . . . . Plate IV., p. 402.
German, percussion fuse . . . Plate V., p. 403.
Pettman (British), percussion fuse Plate VI., Fig. 1, p. 404.
Royal Laboratory (British), percussion fuse. Plate VI., Fig. 2, p. 405.
Lissberger, percussion fuse . . . Plate VII., Fig. 1, p. 406.
time percussion fuse . . . Plate VII., Fig. 2, p. 407.
German, time percussion fuse . . Plate VIII., p. 408.
M'Intyre, time percussion fuse . Plate IX., p. 409.
Gill, combination fuse (No. 1) . Plate X., p. 410.
Gill, combination fuse (No. 2) . Plate XI., p. 411.
O'Reilly, combination fuse . . Plate XII., p. 411.
Thompson, combination fuse . . Plate XIII., p. 412.
Ware, combination fuse (No. 1) . Plate XIV., p. 413.
combination fuse (No. 2) . . Plate XV., p. 414.
Treadwell, combination fuse . . Plate XVI., p. 415.
Ruben & Fornerod, combination fuse . . . . . Plate XVII., XVIII., p. 416.

M'Intyre, combination fuse . . Plate XIX., p. 418.
Plumacher, percussion fuse . Plate XXI., p. 420.
Stateham . . . . . * "*Sc. Am. Sup.*," 2644
Freneh, time . . . . . *Laboulaye's* "*Dict.*," art. "*Artifices de guerre*," i., Fig. 171.
percussion . . . . . *Ibid.*, i., Fig. 169.
Prussian, pereussion . . . . . *Ibid.*, i., Fig. 170.

Fu'si-ble Met'al. An alloy with a determinate fusing point, and placed in a position to melt and allow escape of steam or to sound an alarm when the stated temperature is exceeded.

A number of tables of alloys with indicated melting points are given on p. 62, "*Mech. Dict.*" To these may be added, —

	Bismuth.	Lead.	Tin.	Antimony.	Melting Point, Degrees, Fah.
D'Arcet . .	8	5	3	–	Below 212
	2	5	3	–	Below 212
Walker . .	8	5	4	1	–
Onion . .	5	3	2	–	Below 197

By adding to the last given, mercury 1 part on taking the metal from the fire, an alloy will be obtained, which is liquid at 170° Fah. and only solid at 140°. Used for anatomical injections.

French cliché molds are made of the Walker alloy.

Electrotype molds of d'Arcet's and Walker's. Also for metallic pencils and laboratory baths.

Fig. 1121.

Fu'si-ble Plug. One placed on a steam boiler or in an electric circuit (fire alarm), which melts when subjected to a heat exceeding the point for which the alloy is constituted. See Fusible Alloy.

Fusible Plug.

The plug shown is covered with fusible metal and the spaces filled with the same. Water from the boiler circulates in the tube around the plug; the latter being screwed into place is readily removed, refilled, and replaced.

Fu'sing Disk. An invention of Jacob Recse, of Pittsburg, for cutting round steel bars.

It consists of a disk of soft steel 3-16″ thiek and 42″ diameter, making 240 revolutions per minute, whieh gives a travel of about 2500′ to the edge of the saw. The round bar travels in the same direetion 200 revolutions per minute, so that the edge of the disk and the surface of the bar move in opposite directions.

A round bar of steel 1⅝″ in diameter is fused in two in 10 seconds without being at any time in contact, the kerf being 5-16″ wide. The disk remains cool; the bar is heated.

"*Engineer*" . . . . . * l. 259.
"*Scientific American Supplement*" . . . 4138.

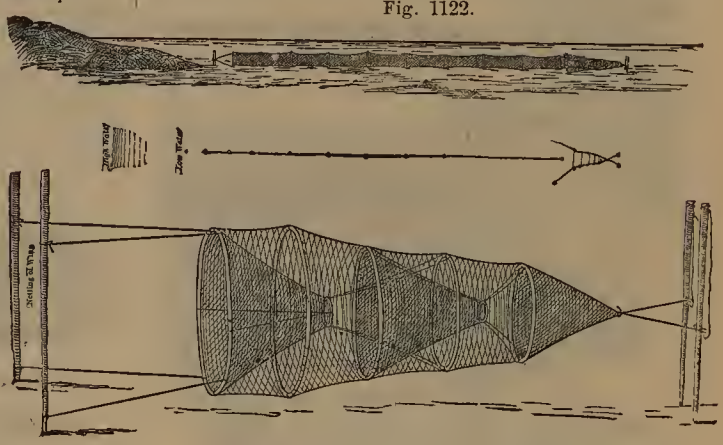
The eircular saw for the removal of the fag ends of rails and hars while yet hot from tbe rolls is an apparatus used in many rolling mills. See Hot Iron Saw, *infra*.

Fyke Net. (*Fishing.*) A bag net with distended mouth and succession of funnel-shaped compartments.

In the upper part of the illustration a long *leader* is shown conducting the fish along shore into the fyke net. The netting of the wings is not shown, but extends from the stakes to the mouth of the *fyke*, and the end of the leader enters between the displayed wings, which are perhaps 5′ high and 20′ long. The leader, 100′ long, 5′ deep. The fyke has 5 hoops, 9′ to 15′ in circumference.

Under Net will be found a list of names of various pounds and traps, some of which embrace the same feature.

Fig. 1122.



Tyson Fyke Net.

G.

Ga'bi-on. A basket, or frame of open work, used in hydraulic and harbor works to form a bar, dyke, or jetty. Cognate contrivances, as fascines, mats, etc. (which see), have a similar purpose; forming a nucleus for the holding of broken stone, gravel, or sand; or for the collection of sand or silt brought by the current, tides, or waves. See list under Hydraulic Engineering.

The gabions of the Galveston jetty works are thus made: A bottom of 2″ planks is bored for the reception of upright pine poles, which have the bark left on them and these are held in position by a frame fastened to their tops. They are then wattled with the southern eane, which is so abundant. The gabions are stayed with eross braces internally, a ballast of concrete laid over the bottom and rammed, the top stayed by planks, the stakes nailed to the planking above and below, and the top and bottom planks tied together with ¾″ iron bolt rods. The gabion then receives two coats of eement and is allowed to dry for two weeks; sueh a gabion is 12′ × 6′ and 6′ high. The gabions are sunk upon a foundation mat of eanes wattled on a frame of wood, and fascines of cane are thrust into the intervals between the standing gabions, whieh are planted by means of guide poles and are sunk by pumping them full of sand. Mats, faseines, and eoncrete blocks are arranged upon and around the group of gabions by divers.

See Jetty, *infra*, where the system adopted by the Duteh is represented. See also * "*Scientific American Sup.*," 245.

Ga'bi-on-ade'. A structure consisting of a number of gabions filled with sand or stone and sunk in lines upon fascines or hurdle mats, as a core for a sand shoal in harbor improvemcnts. See "Works in Galveston Harbor."

"*Engineering*" . . . . . * xxiv. 235.

Gad'ding Car. (*Quarrying.*) One arranged to carry a drilling machine so as to present it to drill a series of holes in line. Used especially in getting out dimension stone.

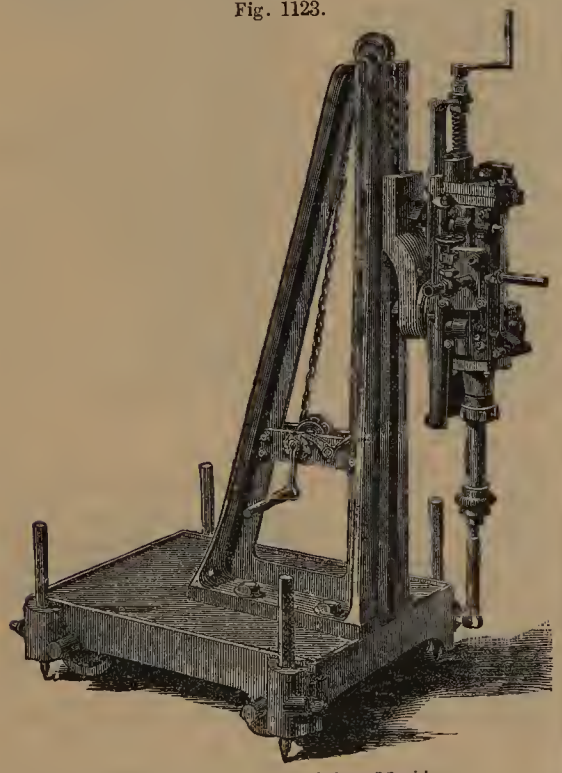
See also Channeling Machine, Fig. 1246, p. 526, "*Mech. Dict.*;" the latter, however, works with chisels and makes a groove instead of a series of holes for as many *gads*, by driving which the stone is riven on the line of holes.

Fig. 1123 shows the drill mounted on car for gad-

ding. It may be presented horizontally for heading, and lowered or raised on the column so as to make the horizontal holes at any altitude or at any angle.

The name is derived from the *gads*, or wedges which are used to rive the block after the row of holes has been drilled or jumped. The *gad* is shown in Fig. 2140, page 932, "*Mech. Dict.*" Another mode of splitting dimension stone upon the line of a row of holes is by means of the *plug-and-feather*, Fig. *a*, 3834, p. 1749, *Ibid.* In this case a wedge is driven between two oblique-faced plugs previously introduced into the hole. Each hole of a linear series being thus furnished, the wedges or gads are tapped in order down the line, again and again, until the stone parts on the line thus weakened and strained.

Fig. 1123.



Gadding Car and Drilling Machine.

Gaff. (*Fishing.*) A hook on a staff used in landing heavy fish; for salmon, halibut, cod, dory, etc.

The *pewgaff* is used in handling and pitching fish.

Gaff-top'sail Hook. (*Nautical.*) A mousing hook for a gaff topsail with rope sheet.

Fig. 1124.

Gaff-topsail Hook.

Gag. (*Surgical.*) An apparatus for distending the jaws during examination of or operation upon the mouth, fauces, etc., or in reducing lock-jaw. *Speculum oris.*

Figs. 259, 264, Part II., *Tiemann's "Armamentarium Chirurgicum."*
See also Fig. 3245, p. 1487, "*Mech. Dict.*," and CHEEK RETRACTOR, Fig. 606, p. 192, *supra.*

Gage. A tool for measurement, inside or outside.

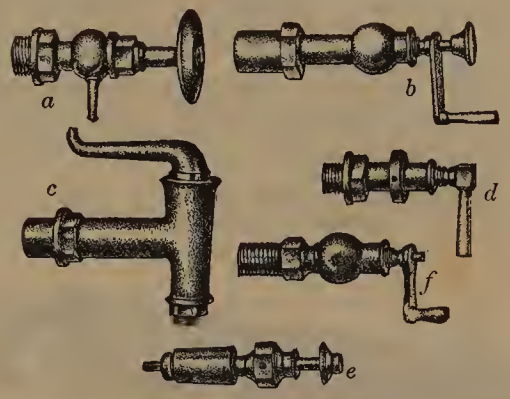
See CALIPER; CYLINDRICAL GAGE; MEASURING MACHINE; CORRECTIVE GAGE, etc., *supra*, *infra*, and in "*Mech. Dict.*;" also list under GAGE, p. 933, *Ibid.*
See also list under MEASURING AND CALCULATING INSTRUMENTS, *infra.*

Gaging and measuring implements. * "*Am. Manufact.*," Mar. 28, 1879, p. 13.
Gages and Calipers, Standard * "*Journal Franklin Inst.*," March, 1879.
* "*Engineering*," xxvii. 407.
* "*Iron Age*," xxiii., Jan. 31, p. 63.
Gaging appa., Barrel, Aust. . * "*Engineer*," l. 404.
Gage, Carpenter's, etc., *Stoner* * "*Sc. Amer.*," xxxvi. 406.
Gages . . . . . * "*Sc. Amer.*," xxxvi. 373.
Gaging casks, etc. . . . . *Keene's "Handbook of Practical Gauging."*

Gage Cock. A trycock to ascertain depth of water in a steam boiler.

Borden . . . . . * "*Scientific American*," xxxvii. 294.
McCool & Elliott . . . * "*Iron Age*," xxi., April 18, p. 5.
Meyer . . . . . * "*Iron Age*," xvii., March 30, p. 1

Fig. 1125.



Gage Cocks.

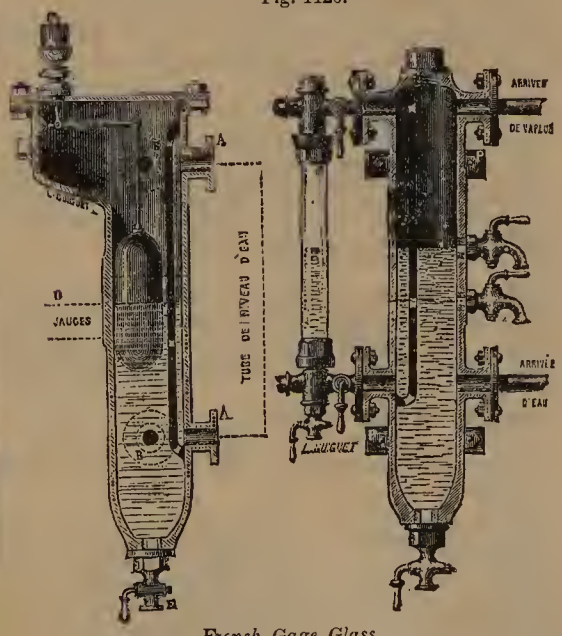
a. Gage valve; wooden wheel.
b. Gage cock; lever handle.
c. Gage cock.
d. New York gage cock.
e. Mississippi gage cock.
f. Gage cock.

Gage Glass. A glass placed on a boiler to show the water level therein.

Fig. 1126 shows the gage glass of Damourette, Paris.

The instrument on the left is intended to be placed directly upon the boiler and has a float operating an alarm whistle when the water sinks below a given level. The dotted lines show the position of the glass tube.
The instrument on the right communicates with the boiler

Fig. 1126.



French Gage Glass.

by two pipes for water and steam, and has all the fittings, gage cocks, glass, tube cocks, sediment cock, etc.
The interposition of the chamber makes a slack-water between the boiler and gage glass which prevents the effect of ebullition manifesting itself in the latter, and the chamber also acts as a sediment catcher, keeping the glass clean.

Gage glass fittings, *Blake*, Br. . * "*Engineering*," xxix. 186.

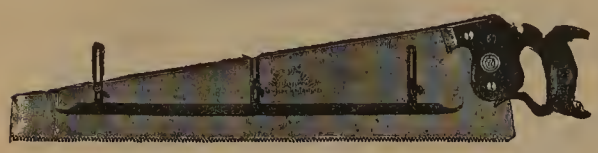
Gage Lathe. A lathe for turning work to size: handles of all kinds, chair legs, pillars and rounds, bedstead rails, beaded work and *nulled* spindles are turned to patterns also, but this speciality constitutes the machine tool a *nulling* lathe.

In the more perfect forms of gage lathes for turning exceptional shapes, three cutting-tools are used: one for turning the stick to a rough cylindrical form; a second to rough out the irregular outlines wanted; and a third to smooth-finish it. The second cutter is caused to approach or recede from the line of centers by a templet, against which the tool-holder rests and along which it slides. The roughing-tools are of the usual V-shape. The finishing-tool is a long blade, set at an angle with the center line of the lathe in order to take a smooth shaving. Its edge is given such a shape that it finishes the work accurately.

The piece to be turned is supported between centers by a ring, and the workman is thus enabled to turn a comparatively long and slender stick. The movement of the slide-rest which actuates the cutters is checked at the end of its throw by a self-acting stop.

Gage Saw. A hand saw with a gage bar adjustable to determine the depth of kerf.

Fig. 1127.



Gage Saw.

Gage Wheel. (*Agricultural.*) A wheel on the forward end of plow beam, to limit the depth of furrow. Fig. 850, p. 267, *supra*, shows a plow with a pair of gage wheels.

Gage Ta'ble-shears. A machine for cutting straw and mill boards to a regulated width, for book covers, box making, etc. See BOARD CUTTER, *supra*, and Fig. 739, p. 311, "*Mech. Dict.*"

Gag'ger. (*Molding.*) A piece of iron in a mold to hold a core in place. A *chaplet.*

Gaiffe Bat'te-ry. (*Electricity.*) There are several forms of batteries by this inventor.

a. Chloride of silver battery, "*Niaudet*," American translation, * 206; "*Telegraphic Journal*," * vi. 398.

b. Sulphate of mercury battery, "*Niaudet*," * 147. (Elsewhere credited to *Marie-Davy.*)

c. Improvement on *Leclanché*, "*Scientific American Sup.*," 3189; "*Telegraphic Journal*," vi. 185.

d. Chloride of zinc, "*Technologiste*," xli. 43.

A number of holes are drilled into a porous carbon cylinder, and filled with a coarse powder of manganese ore. The cylinder is connected with a rod of amalgamated zinc, and the whole plunged in a solution of 20 parts of chloride of zinc in 100 parts of water. — "*Comptes Rendus.*"

See also * "*Scientific American Sup.*," 129.

Gain. A notch, as made in the side or edge of a piece of timber to receive another bar of the frame. See illustration in SCARF, Fig. 4660, p. 2051, "*Mech. Dict.*" See also GAINING MACHINE, Fig. 2044, p. 935, *Ibid.*

Gal'ley Knot. (*Nautical.*) A form of knot. See 10, Fig. 2777, p. 1246, "*Mech. Dict.*"

Gal-van'ic Bat'te-ry. See under the following heads: —

Aërated battery.
Agglomerated battery.
Alum Battery.
Aluminium battery.
Anderson battery.
Bagration battery.
Balloon battery.
Becquerel battery.
Bichromate battery.
Breath battery.
Buusen battery.
Callan battery.
Callaud battery.
Camacho battery.
Carbon battery.
Carré battery.
Chloride of lime battery.
Chloride of silver battery.
Chloride of tin battery.
Chromic acid battery.
Clamond battery.
Coke consuming battery.
Column battery.
Compound plate battery.
Constant battery.
Couronne de tasses.
Cruikshank battery.
Daniell battery.
De la Rue battery.
Double fluid battery.
Dry pile.
Earth battery.
Electric battery.
Faure battery.
Flowing battery.
Frommhold cell
Fuller battery.
Gaiffe battery.
Galvano-caustic battery.
Gas battery.
Graphite battery.
Gravity battery.
Grenet battery.
Grove battery.
Hill battery.
Inversion battery.
Latimer-Clark battery.
Leclanché battery.
Leydeu battery.
Magazine battery.
Magnetic battery.
Marie-Davy battery.
Marine battery.
Maynooth battery.
Mechanical battery.
Meidinger battery.
Menotto battery.
Mercury battery.
Micro-battery.
Moist battery.
Muirhead battery.
Muneke battery.
Niaudet battery.
Nickel battery.
Perchloride of iron battery.
Perfluent battery.
Peroxide of lead battery.
Peroxide of manganese battery.
Plunging battery.
Pneumatic battery.
Poggendorf battery.
Ponci battery.
Potassium chlorate battery.
Prism battery.
Pulvermacher battery.
Quicksilver battery.
Reservoir battery.
Sal ammoniac battery.
Sand battery.
Secondary battery.
Sea battery.
Siemens-Halske battery.
Single-fluid battery.
Smee battery.
Spiral battery.
Standard battery.
Storage battery.
Sulphate of lead battery.
Sulphate of mercury battery.
Thermo-electric battery.
Thomson battery.
Tom thumb battery.
Tray battery.
Triple-fluid battery.
Trouvé battery.
Trough battery.
Tyer battery.
Urine battery.
Varley battery.
Voltaic pile.
Walker battery.
Wollaston battery.

See also the following: —

Ergstrom. *Howell.* *McCarthy.* *Slater.* *Gutensohn.* } "*Scientific American Sup.*," 3791.
Plush . . . . . "*Scientific American Sup.*," 2751.
Watson . . . . . * "*Scientific American Sup.*," 524.

The lists commencing on the next page include all that is important in galvanic batteries up to date, so far as covered by patents.

Gal-van'ic Cur'rent. (*Electricity.*) The direct current from the galvanic battery. The primary current.

Gal'van-i-zing. Treated on p. 939, "*Mech. Dict.*"

"Pickle the article six or eight hours in water containing about 1 per cent. of sulphuric acid held in wooden vessels; the acid requires to be renewed from time to time, according to the quantity of iron pickled. After pickling, scour and wash well in clean water. Keep the article under clean water (in which a little freshly burnt lime has been stirred) until ready for the next process. Immerse in chloride of zinc for one or two minutes until a skin of fine bubbles is formed on the surface. Chloride of zinc may be formed by saturating hydrochloric acid with metallic zinc until effervescence ceases, then decanting and adding a little sal-ammoniac. Dry the article on a heated iron plate, then immerse it in a bath of molten (not glowing) zinc until it acquires the temperature of the zinc bath. The surface of the molten zinc should be protected by sal-ammoniac, or some other substance. In some cases there is a partition at the surface of the bath, one portion of the surface being protected with sal-ammoniac, the other with a layer of charcoal. Beat the article while hot, to remove the excess of zinc." — *Molesworth.*

Galv. electric bath, *Potin* . . * "*Scientific Am.*," xxxiv. 54.

A carefully written and full article on the zincing of iron surfaces, "*Scientific American Supplement*," 2798.

Iron . . . . . "*Iron Age*," xxiii., Jan. 16, p. 9.
"*Manufacturer & Builder*," ix. 157.
Bath . . . . . * "*Scientific Sup.*," 2560.

Gal'van-i-zing Fur'nace. The bath of molten zinc in which iron is plunged to coat it.

The galvanizing furnace of Thum, of Laubach, Germany, is a reverberatory in which the zinc bath is heated from above. It has a fireplace and a chimney at each end, the part of the hearth connecting the two being arched over. The rest of the rectangular hearth is perfectly open above, so that the heat-conducting power of the metal is relied upon to keep it at the proper temperature in that part of the hearth. The slabs of fresh zinc are introduced through doors communicating with the hot ends.

Names.	Number.	In Positive Cell.		Diaphragm.	In Negative Cell.		REMARKS.
		Metal.	Liquid.		Liquid.	Metal.	
Coad, P.	2,521	–	–	–	–	–	Plunging, with vertical scale.
Plumbe, Jr., J.	2,984	–	–	–	–	–	Cell has spout for pouring.
Harrington, D.	4,176	–	–	–	–	–	
Olmstead, A. D.	6,362	–	–	–	–	–	Plates or wires inserted through perforated cap.
Drescher, L.	9,447	zinc.	–	flannel.	–	copper.	Voltaic pile; perforated plates.
Farmer, M. G.	9,530	–	–	–	–	–	Porous cell, partly glazed.
Pulvermacher	9,571	–	–	–	–	–	Plates depend from hinged lid.
Chester, C. T.	12,855	–	–	–	–	–	Overlapping clamp for plates.
Hull, A. G.	17,095	–		–	–	–	Battery for electrizing the blood.
Seaver, E.	19,209	zinc.	water.	sulph. copper in porous cell.	sulph. cop.	copper vessel.	
Elmendorf, J.	19,245	zinc.	–	–	–	platinum.	Pole wires attached to electrodes with fusible alloy.
Doyle, G.	19,759	zinc.	–	–	–	copper.	Plate clamps are screwed.
Grenet, Jr., E.	25,503	zinc.	–	partly imperv.	–	charcoal on lead.	Agitates excitant by current of air.
Avery, T. C.	25,710	zinc.	H_2SO_4.	porous cell.	HNO_3.	bifurc. plat.	Zinc amalg. outside with mercury, lead, or tin, rosin, tallow.
Vergues, M.	28,317	zinc cell.	H_2SO_4.	porous cup.	nitric ac.	platinized coke.	Platinum strips around central glass cylinder.
Kirchof, C.	31,545	platinum.	nitr. acetates of	–	–	platinum.	Secondary battery.
Chester, C. T.	38,146	–	lead, potash, fc.	–	–	–	Attaching carbon electrode.
Hill, E. A.	39,571	zinc.	sodium chloride.	–	sulph. copper.	copper.	Gravity battery.
Reissue	2,502	–	–	–	–	–	
Frazer, E. J.	40,537	zinc.	–	–	–	copper.	Removable zinc rest on rubber gasket on cap.
Freed, G. W.	43,014	zinc.	dilute acid.	–	–	copper.	Plates fit in grooves in vessel; tight gutta percha cover.
Brown & Baldwin	47,389	mal. iron bars.	–	porous cell.	–	gas coke.	Single negative with several positives on neg. cell; perforated cover.
Blackie, J.	49,824	zinc.	acid.	–	–	silver.	Zinc wholly immersed rests in mercury cup.
Chester, C. T.	51,144	–	–	–	–	–	Platinum-faced clamp for carbon.
Farmer & Smith	51,442	–	–	–	–	–	Thermo-electro. Alloy of antim. and zinc over enameled metal core.
Splitdorf, H.	52,617	zinc.	–	–	–	carbon.	Wire connection and clamp.
Percival	53,668	–	–	porous plate.	–	–	Secondary pile with carbon electrodes.
Leclanché, G. L.	55,441	zinc in sand.	chl. hyd. amm.	sand.	carb. copper.	copper.	Jar corked and sealed.
Reissue	5,769	–	–	–	–	–	
Ogden, A. S.	55,892	–	–	–	–	carbon.	Wire connects by platinum with carbon.
Dixon, J.	57,687	zinc.	–	–	–	graphite and clay.	Neg. forming porous cell insulated by rings from zinc
Fritz, H.	63,032	zinc.	hot acid.	–	–	copper vessel	Single fluid. Air-tight case.
Bruso, P.	63,848	–	–	–	–	–	Pivoted adjustable connecting arm.
Leclanché, G. L.	64,113	zinc.	chl. hyd. amm.	sand or sawdust.	graph. and per-ox. mang.	graphite.	Also secondary battery with carbon electrodes.
Reissue	5,768	–	–	–	–	–	Alkaline solution, powdered graphite.
Nichols, G. W.	68,779	–	sod. chl. and	–	–	–	Insulates the whole apparatus.
Boulay, C.	70,791	zinc.	sulphur.	porous cell.	sulph. cop. nitr.	copper.	Sealed by shellac and brick dust. Liq. to excitants thr. porous walls.
Garratt, A. C.	72,628	zinc.	vinegar.	cloth.	pot.	brass.	Voltaic pile with space between plates.
Fritz, H.	74,905	zinc.	hot acid.	porous cell.	–	copper vessel.	Containing vessel forms outside element.
Garratt, A. C	79,567	zinc.	–	–	–	copper.	Voltaic pile. Plates in contact at edges.
Fleury, A. L.	79,819	–	–	–	–	–	Steam impinging on points generates electricity.
Palmer, H.	82,981	zinc.	–	cloth or paper.	–	copper.	Voltaic pile. Elements have wire connections.
Chester, C. T.	86,134	zinc.	–	–	–	carbon.	Inverting of battery.
Gerger, J. J.	86,221	zinc.	–	–	–	copper.	The zincs projects horizontally between the coppers so as to interlock.
Garratt, A. C.	89,036	zn. or magnes'm.	vineg., sea-water.	–	–	copper or bronze.	Pairs separated by strips of rubber.
Calland, J. A.	96,199	zinc.	sulph. zinc.	–	sulph. cop. [acid.	copper.	Imp. gravity fixtures, supports, etc.
McPherson, J. R.	97,949	fe. jar met. chips.	acid or sal amm.	porous cell.	per-ox. mang. nit.	carbon.	Cock for draining.

GALVANIC BATTERIES. LIST OF UNITED STATES PATENTS (*Continued*).

Names.	Number.	In Positive Cell.		Diaphragm.	In Negative Cell.		REMARKS.
		Metal.	Liquid.		Liquid.	Metal.	
Hoe, P. S.	99,192	–	–	–	–	–	Rectangular glass box lined with paraffine.
Meyer, C. W.	102,295	–	–	–	–	–	Portable medical battery; induction coils, etc.
Hill, J.	103,331	merc. and zinc.	–	–	–	cop. wire cloth.	Zn. in annular glass suspended from rim of outer cup. Cu. above zn.
Chutaux, T.	105,042	zinc.	–	–	–	carbon.	Plunging and inverted magazine. Liquid falls from cell to cell.
Chutaux, T.	105,043	zinc, iron.	–	sand.	granulated coke.	carbon.	Zinc in lower; iron in upper cells.
Robertson, O. W.	105,252	–	–	–	–	–	Insulator cell support.
McCracken, E. D.	106,383	–	–	–	–	–	Switch for connecting.
Kidder, J.	108,602	zinc.	–	–	–	platinum.	Neg. electrode coiled around suspended core. Elastic plug.
Farmer, M. G.	109,603	–	–	–	–	–	Thermo-electr. Pairs in curved tiers around heat.
Cook, D. M.	110,206	–	–	–	–	–	Several porous cups in one cell.
Cook, D. M.	113,399	–	–	–	–	–	Several porous cups in one cell wrapped with paper and wire.
Farmer, M. G.	113,864	ant. and zn. alloy.	–	mica.	–	Ger. silver cu.	Thermo-electric.
Hill, E. A.	114,005	zinc.	–	–	–	–	Quoit-shaped zinc suspended from rim of cell.
Hill, E. A.	114,006	zinc.	H_2SO_4.	–	sulp. cop.	copper.	Zinc suspended from rim of cell. Central tube supplies sulp. copper.
Klinkerfues, W.	114,950	zinc.	–	–	–	carbon.	Gas lighting auxiliary flame from gas of battery.
Powel, J. W.	115,519	–	–	–	–	–	Plunging. Trough-plates slide through elastic cover.
Little, G.	115,936	–	–	–	–	–	Automatic switch; alternating batteries.
Kidder, J.	116,451	zinc.	–	–	–	copper.	Separate binding post for each cell, with switch connection.
Drescher, L.	117,057	zinc.	–	–	–	carbon.	Grenet form modified.
Prevost, E.	119,175	conical zinc.	–	carbon cup.	nit. sod.; bichr. pot. H_2SO_4.	carbon	Insulating collar round carbon opposite top of zinc.
Bastet, L.	119,298	zinc.	H_2SO_4.	porous cell.		carbon.	Perforated partition in porous cell.
Himmer, V.	119,763	zinc.	H_2SO_4.	small cup; half height.	sulp. cop.	copper.	Sulp. in short cup saturated by tube from inverted globe.
Kidder, J.	119,855	–	–	–	–	–	Plates in one leg of L-shaped cell. Plunged by tipping.
Callaud, J. A.	120,034	zinc.	sulph. zinc.	–	sulp. cop.	copper.	Gravity. With positive vertically adjustable.
Robbins, J. A.	120,327	tin.	–	–	–	carbon.	
Leland, E. J.	120,651	zinc.	sol. sulp. ac.	porous carb. cup.	sulp. merc.	platinum.	
Kidder, J.	120,750	–	–	–	–	–	Sliding cell coupler. Trough battery.
Klinkerfues, W.	122,389	zinc.	–	–	–	carbon.	Gravity; gas lighting; cell around gas pipe; turning on gas excites bat.
Robbins, J. A.	128,660	zinc plates.	–	porous cell.	–	carbon plates.	Elements duplicated.
Linke, C. A.	129,148	zinc.	–	–	–	carbon.	Negative depolarized by jet of steam.
Davis, A. G.	129,465	–	–	–	–	–	Insulating cell support.
Phelps, G. M.	130,593	zinc.	–	–	–	copper.	Gravity; zinc of peculiar shape and adjustable.
Wilder, W. J.	132,997	corrug. zinc.	–	porous cup.	–	copper.	Outer surface of zinc varnished.
Davis, A. G.	134,364	zinc.	–	–	–	copper.	Star-shaped elements; central tube; perforated cork stopper.
Thomas, J. H.	136,191	–	–	–	–	–	Insulating support collects leakage.
Lockwood, R. M.	137,556	zinc.	sol. sulp. acid.	–	sulp. cop.	spiral cop. wire.	Gravity.
Bastet, L.	138,602	zinc.	nitr. hyp. sulp. sod.	porous cell.	nit. sod. and H_2SO_4	carbon.	Zinc for magazine, with gauze bottom. No amalgamation.
Wolf, A. L.	142,052	zinc.	–	–	ozone.	carbon.	Air or ozone injected through tubes.
Edison, T. A.	142,999	zinc.	sulp. zinc.	–	sulp. cop.	copper.	Gravity. Hor. copper plates between liquids to protect zinc against cu.
Ashcroft, E. H.	145,143	–	–	–	–	–	Non-freezing battery.
Lockwood, R. M.	149,320	zinc.	sol. sulp. acid.	felt.	sulp. cop.	copper.	Gravity. Zinc supported by insulating columns from copper.
Breslin, M.	149,635	zinc.	sulp. zinc.	–	sulp. cop.	copper.	Gravity. Negative in pyramidal form.
Clamond, C.	151,568	zinc.	–	–	–	antimony.	Thermo-electric.
Nolf, A. L.	153,841	zinc.	–	–	–	carbon.	Carbon cell with impervious coating.
Snow, W. D.	155,209	zinc.	earth.	earth.	–	carbon.	Several plates. Obtains intensity as well as quantity.
Arthur, R.	157,778	zinc fragments.	H_2SO_4.	porous cell.	HNO_3	carbon.	Perforated earthen jar holding zn. Has a cavity in floor for mercury.
Bryan, J. C.	160,152	zinc.	sulphur, earth.	–	–	copper.	Plates partially imbedded in sulphur.

Leiter, J.	161,246	–	–	–	–	–	Two-story. Pl. above. reserv. below. Forces liq. up. Autom. water feed.
Davis, W. M.	162,806	zinc.	sulp. zinc.	porous cell.	sulp. cop.	copper.	Bell rung when salt is exhausted.
Keegan, V. E.	163,318	zinc.	water.	sulp. acid in porous cell.	nitr. ac. –	carbon. carbon.	Outer porous cell surrounded with coil of wire conn. to zinc. Neg. broken carbon in perforated tube of cop., lead, clay, gutta-percha.
Dechert, H. P.	165,312	–	–	–	conglom. grap. per ox. mang.	– –	
Leclanché, G. L.	165,452	zinc.	chl. amm.	–	–	–	Plunging. Adjustable plates, shallow cell; partitions for rapid filling.
Kidder, T.	166,012	–	–	leaden plate.	sulp. cop.	copper.	Sulp. copper introduced through central leaden tube. Gravity.
Hill, E. A.	167,173	zinc.	H_2SO_4.	–	–	copper.	Agitator between negative and perforated positive.
Dawson, B. F.	167,510	zinc.	–	–	sulp. cop.	copper.	A suppl. positive plate attachable to the zinc.
Duhem, C.	169,529	zinc.	sulp. zinc.	porous cup.	sulp. cop.	copper.	Zinc in porous cup which rests on cu. supported by sulphate.
Lockwood, R. M.	170,864	zinc.	sol. sulp. ac.	–	–	–	Portable; plunging; trough; sliding cell connector.
Kinemund, F. C.	175,112	–	–	perforated cell.	graph. mang.	graphite.	Battery sealed.
Warden-Muirhead	175,884	slotted zinc.	chl. amm	–	sulp. cop.	copper.	Gravity; adjustable zinc; aux. copper disk above copper solution.
Bliss, G. H.	176,270	zinc.	sulp. zinc.	–	sulp. cop.	copper.	Receiver att. to feeding tube between zn. and cu. to catch zn. residue.
Brunelle & Mohr	177,056	zinc	sulp. zinc.	fibr. absorbent.	–	copper.	Voltaic pile. Disk-shaped elements.
Pulvermacher, J. L.	177,273	zinc.	vinegar.	–	–	–	Float regulates supply to service pipes of cells.
Einbigler, R.	177,996	–	–	–	sulp. cop.	perforated lead.	
Watson, J. E.	178,215	zinc.	sulp. zinc, acet. lead, water.	–	–	plat. plated cop.	
Byrne, J.	182,101	–	–	–	–	carbon.	Portable. Plunging. Two sets of cells, induction coils, etc.
Kidder, J.	182,293	zinc.	–	wood.	–	copper.	To be imbedded in earth
Cerpaux, J.	182,802	zinc.	earth.	–	–	copper.	Zn. supp. by copper hangers which compl. circuit when zn. is removed.
Parrish, M. W.	183,201	zinc.	–	–	–	cop. coated with lead and plat.	
Byrne, J.	183,748	zinc.	–	–	chl. calcium.	silver foil.	Hard rubber ends; soft rubber sheathing.
Dechert, H. P.	184,005	–	–	blot. pap. or sand.	chl. silver.	carbon.	
Van Tenac, C. L.	184,932	zinc wire.	chl. zinc.	porous cell.	nit chr. ac. H_2SO_4	lead.	Gravity.
Bastet, L.	185,160	zinc. [nit.-chr. ac.	bi-cbr. pot. H_2SO_4.	–	oxychl. lead.	cop. in two sec'ns.	Double connecting spring clips. Siphon connecting from cell to cell.
Brush, C. F.	185,288	zinc.	sod. chloride.	–	–	carbon.	Portable battery. Commutator, etc.
Parrish, M. W.	189,779	zinc.	–	–	–	copper.	Plunging. Rotating plates.
Jennison, C. R.	190,684	zinc.	acid.	–	–	–	Thermo-electric.
Hussey, C. A.	195,762	zinc cup.	–	–	–	carbon.	Absorbent material surrounding plates.
Wray & Wray	197,196	–	–	–	–	carbon.	Grenet form. Cup held by spring catches.
Hussey, C. A.	291,924	bottomless zn. cup	–	por. cell perf. bottom.	–	carbon.	Tray battery; pressed together by a spring.
Boekel, W.	203,405	zinc.	bichr. pot.	cloth, paper, sponge, pulp.	sulp. cop.	copper.	Perfluent battery. The plates form the partitions.
Cutten, E. B.	206,166	zinc.	sulp. zinc.	fibrous material.	–	–	
Griscom, W. W.	207,270	–	–	–	–	perf. plate.	Leclanché arr. Impd. clamp for carbon.
Lander, G.	208,614	met. sulphuret.	–	–	–	carbon.	Plunges by lifting trough. Water-tight cover.
Kreis, A. C.	210,460	zinc.	–	–	–	carbon.	
Bartlett, F. C.	210,835	zinc.	–	porous cell.	mixt. carb., ant.	antimony.	Zinc in felt and copper in coke.
Bastet, L.	211,213	zinc.	salt water.	–	coke.	copper.	
Drawbaugh, D.	211,322	zinc, felt.	earth.	–	–	–	Porous cup.
Ehrenberg, C. A.	215,899	–	urine.	porous cell.	sod. nitr. H_2SO_4.	carbon.	Amalgam between carbon and yoke.
Wilson, W. S.	216,774	zinc, sulph. sod.	sand, per-ox. and sod. nitrate.	–	–	carbon.	Closed receiver for gases emitted.
Rogers, W. H.	217,023	–	–	–	carbonaceous	matter.	Liquid raised by plungers into contact with plates.
Jablochkoff, P.	219,056	fused nitrates.	–	cell porous half way down.	–	copper.	Gravity.
Hopkins, G. M.	219,477	zinc.	–	–	–	carbon in merc.	Intermediate plate for depositing positive metal.
Fitch, D. H.	219,631	zinc.	merc'c, merc's, or amm. chl.	copper.	–	copper.	Adjustable magazine. Perforated platinum bottom.
Thomson-Houston	220,507	zinc.	chl. amm.	porous cell.	oxal. chrom.	carbon.	Flexible cap. Zinc fits inner surface of cell.
Anderson, R. C.	223,212	zinc.	–	cloth.	–	platinum.	
Converse, G. A.	224,378	zinc cup.	–	–	gran. retort carb.	platinum.	Automatic supply from magazine by clock-work.
Maynard, W.	224,343	zinc.	–	–	–	–	Two-story; liq. raised by displacement; ann. groove with merc. supp. zn.
Doyle, J.	224,404	–	–	–	–	carbon.	Gravity. Inverted reservoir with two connecting pipes.
Tommasi, F.	227,076	zinc.	–	–	sulp. cop.	copper.	
Schlumberger, R.	227,448	zinc.	sulp. ac.	–	per ox. lead, H_2SO_4	carbon.	Battery case.
Lockwood, W. V.	227,805	zinc.	sal. am.	porous cell.	–	–	Plates in upper cell sep. from lower chamber by plugged partition.
Watts, J. H. C.	227,865	–	–	–	–	–	Cell slides vertically in a reservoir and has valves below.
Bartlett, S. H.	228,972	–	–	–	–	–	Liquid forced up into cells by pneum. pressure from reservoir below.
Bartlett, S. H.	328,973	–	–	–	–	–	The coke and chl. calc. in alternate layers in the sealed porous cup.
Hardy, M. A.	229,122	–	–	–	–	–	Conglomerate negative containing salt.
Cheever, J. H.	233,601	zinc.	bydr. chl. ac.	porous cell.	chl. calc., coke.	carbon.	Negative rotated by a crank. Single fluid.
Leclanché, G. L.	234,413	zinc.	chl. am.	–	per ox. mang.	carbon.	
Delafield, A. F.	237,830	zinc box.	–	–	–	copper spiral.	

GALVANIC BATTERIES. LIST OF BRITISH PATENTS.

Name.	Date.	Number.	Positive.		Partition.	Negative.	
			Metal.	Liquid.		Liquid.	Metal.
Kemp	1828	*	fluid amalgam of zinc.		–	–	–
Becquerel	1829	*	zinc.	sulp. acid.	Gyps., porcel. clay with sea salt.	salt of copper.	copper.
Daniell	1836	*	zinc amalg.	sulp. acid.	ox gullet.	sulp. copper.	copper.
Mullins	1836	*	zinc.	chloride am.	membrane.	sulp. copper.	copper.
Grove	1839	*	zinc amalg.	sulp. acid.	membrane.	nitr. acid.	platinum.
Spencer	1839	*	zinc.	sulp. zinc.	brown paper.	sulp. copper.	copper.
Jacobi	1840	*	zinc.	sulp. acid.	thin earthenware.	sulp. copper.	lead or cu.
Bunsen	1842	*	zinc amalg.	sulp. acid.	porous cup.	nitr. acid.	coke.
Grove	1842	*	platinum.	oxygen.	acid. water.	hydrogen.	platinum.
Roberts	1842	*	zinc amalg.	sulp. acid.	–	–	cast iron.
Wöhler & Weber	1842	*	iron.	dil. sulp. acid.	porous cup.	strong nit. ac.	iron.
Walenn	1849	*	zn. lead, mer.	sulp. acid.	–	sulp. iron.	cast iron.
de Moleyns	1841	9,053	zinc.	ammon. chl.	sycamore.	nit. am. sulp. acid.	platinum.
Leeson	1842	9,374	zinc or plat.	bye-products nitric acid.	– porous cup.	sulp. pot., etc.	platinum.
Bain	1843	9,745	zinc.	earth.	earth.	earth.	copper.
Piaget	1846	11,448	zinc amalg.	sulp. ac., salt water.	porous cup.	nitric acid.	charcoal.
Brett & Little	1847	11,576	zinc.	–	sand.	–	copper.
Weare	1847	11,776	perf. zinc, zinc amalg.	–	sponge, sand.	chl. calc.	cop. coke.
Highton	1848	12,039	zinc.	ammon. salt.	–	amm. salt.	copper.
Staite	1848	12,212	liq zn. amalg. in a bag, lead.	nit. or act. ac.	–	–	–
Petrie & Staite	1849	12,772	{ zinc. Wire gauze	hydrc chl'ate am., nitr. pot. or punctured	porous cup. plates.	nitric acid.	carbon.
Petrie & Staite	1849	12,847	zinc amalg.	sulp. acid.	thread, asbes., gyp.	bichr. pot.	platinum.
Pulvermacher	1849	12,899	zinc.	sulp. acid.	clay, graphite and sal. amm.	nitric acid.	–
Highton	1850	12,959	zinc.	alum; soluble earthy sulph.	–	–	copper.
Weare	1850	13,142	– gold.	– (dry pile.)	sand, sponge, etc. thin paper.	chl. calc. (dry pile.)	elec. copper. plumbago.
Greenough	1851	13,613	zn. U-shaped.	–	–	–	carbon on iron plates.
Roberts	1852	13,963	tin.	aq. regia. nit. ac. or salts.	–	nit. ac. or nitrates.	platinum.
Roberts	1852	14,198	lead.	sulp. acid.	–	nitric acid.	–
Jackson	1852	14,330	–	–	fabric.	–	–
Petrie	1852	14,346	{ zinc. Decomposable	sulp. acid. nitrogen-	– ous matter.	nitr. silver.	glass plate graphited.
Slater & Watson	1852	595	zinc.	ferrocy. pot. sulp. acid.	–	nitric acid.	iron.
Slater & Watson	1852	595	zinc.	chrom. pot. nit. sulp. ac.	–	cbrm. pot.	platinized lead.
Slater & Watson	1852	–	zinc.	cyanogen or chrom. salt.	–	nitr. iron.	iron.
Desvignes & Kukla	1853	169	lead, zn., tin.	salt.	–	nitric acid.	antim. alloys, rare metals.
Straite	1853	634	lead alloys, anti., zn., tin.	–	–	–	carbon and plat. gauze.
Fuller	1853	944	zinc.	sulp. acid.	–	–	powd. graph.
Fontainemoreau	1853	1,785	zinc.	–	–	–	charcoal.
Fontainemoreau	1853	2,003	zinc.	H. Cl.	–	chl. gas.	carbon.
Meinig	1853	2,361	Antimonic,	phosphoric, or	arsenic acids with	powdered glass	or starch.
Dering	1853	2,486	zinc.	salt.	–	acet. lead.	lead.
Weare	1854	629	zinc.		glue, paper, porous cement, spouge.	–	–
Archereau	1854	713	–	–	partly impervious conden. graphite.	–	–
Archer	1854	1,575	uses spoiled	or impure acid	s, etc.	–	–
Harrison	1854	1,714	sodium, zinc, and mercury.	hypochlorous acid.	asbestos.	–	platinum and iron alloy.
Callan	1854	1,920	zinc coated with mercury. tin, and lead.	carb. sulp. or	phos. sod. permang. or arsen. pot.	sulp. iron.	cast iron.
Callan	1854	2,455	iron and zinc	partly covered	with caoutchouc.	pyrolig. mang. acid.	–
Varley	1854	2,555	zinc.	sol. of zinc.	layer of cloth.	neg. salt.	copper.
Johnson	1854	2,556	zinc.	water.	sand.	sulp. cop.	copper.
Frascara	1855	1	cast iron.	–	paper.	–	coal.
Fontainemoreau	1855	148	zinc.	H. Cl.	–	hypochl. lime	carbon.
Fontainemoreau	1855	1,649	zinc.	chl. sod.	paper gun-cotton.	nitr. soda and H_2SO_4.	carbon.
Derring	1855	2,662	–	–	–	H. Cl. & crys. nitr. soda.	copper, granl. platinum.
Puls	1856	755	iron.	acid.	–	acid.	carbon.
Doat	1856	987	mercury.	iodid. pot.	–	iod. pot. and iodine.	carbon.
Derring	1856	1,546	zinc, iron.	nit. ac. & H_2	SO_4.] –	–	cast iron, carb

* Not patents, but discoveries.

GALVANIC BATTERIES. LIST OF BRITISH PATENTS (*Continued*).

Name.	Date.	Number.	Positive.		Partition.	Negative.	
			Metal.	Liquid.		Liquid.	Metal.
Fontainemoreau . .	1856	2,290	rolled zinc.	sulp. pot.	–	–	copper.
Cumins & Huuter . .	1857	680	zinc.	–	–	–	steel.
Pulvermacher . . .	1857	2,411	zinc.	bichr. and bi-sulp. pot, salt.	–	–	carbon.
Burleigh & Danchell .	1857	3,164	–	–	–	–	carbon, gummy cement.
Weare	1858	165	zinc.	chl. calc.	board.	chloride cop.	copper.
Hunt	1858	282	–	–	graphite cell.	nitric acid.	–
Newton	1858	296	aluminium.	sulp. acid.	cup.	nitric acid.	carbon.
Mennons	1858	805	lead.	sulp. acid.	cup.	nitric acid.	carbon.
Hipp	1858	2.187	zinc.	chl. zinc.	sawdust.	sulp. cop.	copper.
Mennons	1858	2,439	zinc wire.	–	–	–	copper wire.
Meidinger	1858	2,818	zinc.	sulp. zinc.	–	sulp. cop.	copper.
Marçais	1858	2,888	zinc amalg.	sulp. mercury, sulp. acid.	–	bichr. pot.	metalized carbon.
Barclay	1858	2,937	zinc wires.	–	earth.	–	copper wire.
Newtou	1859	1,696	insulat. amag. on zinc.	–	cup, partly impervious.	nitric acid.	two platinum plates
Beardmore	1859	1,896	plates of an	earth battery	in deliquescent salts,	–	
Siemens	1859	2,503	zinc.	–	paper pulp; sawdust.	sulp. cop.	copper.
Mennons	1859	2,922	zinc.	–	–	sulp. lead.	tin.
Vergnes	1860	211	zinc.	–	–	nitr. ac. in oxygeu.	platin. coke.
Mapple	1860	486	–	–	carbon pot. coated inside with platin.	–	–
Silver & Barwick . .	1860	994	–	–	gum and gypsum.	–	–
Morris & Mapple . .	1860	1,515	imbedding car	bon in the sur	faces of glass vessel	s.	
Thomson & Jenkin .	1860	2,047	zinc.	sulp, acid.	sawdust.	sulp. cop.	copper.
Hirsch	1861	1,147	earth battery.	–	–	–	–
Callaud	1861	1,503	zinc.	sulp. acid.	–	sulph. of protox. merc.	carbon.
Tolhausen	1861	2,127	uses chlor-hy	drate and oleic	acid.		
Morris *et al.*	1861	2,298	ziuc.	sulp. acid.	wood or bark.	chl. nat. sod.	oxide copper. copper orc.
Henley	1861	2,464	zinc in merc.	sulp. acid.	–	–	rough copper electro silv'd.
Pulvermacher . . .	1861	2,656	zinc wire.	acid.	thread.	acid.	copper wire.
Dickson	1862	340	iron, zinc, lead, carbon.	sulp. of alk. and earths.	double porous cell.	acids charged with chl. gas.	sub-sulp. cop. platin. iron.
Cook	1862	1,550	zinc.	water.	sand.	sulp. cop.	copper.
Stillé	1863	1,732	zinc.	chl. or nitr. pot.	charcoal and tan.	nitr. ac.	cast iron or carbon.
Varley	1865	619	zinc.	H_2SO_4.	oxi. or carb. zinc.	sulph. cop.	copper.
Piggott	1865	2,213	zinc.	–	chl. calc.	–	carbon.
Moseley	1865	2,421	zinc.	persulp. mer.	–	–	carbon.
Horwood & Brumfit .	1866	338	covers liquids	with grease or	oil.	–	–
Leclauché	1866	670	zinc.	hydrochl. am.	sand. –	oxide of cop. carb. cop.	copper.
Carlier	1866	947	–	–	–	–	carbon and paraffine.
Martin & Varley . .	1866	966	the cells are	lined with resi	nous cement and ac	id sawdust.	–
Leclanché	1866	1,637	zinc.	hydrochl. am.	porous cell and sand.	perox. mag. hydrochl. am.	graphite.
Leclauché	1866	2,623	zinc.	hydrochl. am.	sawdust.	perox. mag hydrochl. am.	graphite.
Rowland	1868	2,836	magnesium.	sulp. magn.	porous cell.	sulp. cop.	copper.
Gedge	1868	1,258	mercury.	hydrochl. ac., chl. pot.	–	–	–
Lyttle	1868	3,129	aux. zinc.	–	clay and ox. ziuc.	–	–
Lyttle	1869	1,250	ziuc.	–	binox. merc. sal am.	–	copper.
Abel	1869	1,441	–	saline sol.	porous cell partly vanished.	H_4 So_4. bichr. sulp. iron	pot: proto. sulp. sod.
Smithers	1869	2,003	–	–	–	chloride lead.	–
Faure	1869	3,324	–	–	clay and powdered graphite.	–	–
Webers	1870	1,055	ziuc.	Na. cl. or NH_4 cl.	sawdust.	perox. manng.	calcined carbon.
Fitzgerald	1870	3,308	zinc wire.	am. NH_4 cl.	paper or plaster.	lead binoxide, copper oxide, silver chl.	brass or silver vessel.
Newton	1871	974	zinc.	the sea.	–	–	copper, etc.
Lyttle	1871	1,535	zinc.	–	porous cell.	sal. amm. binox. mang.	graphite.
Highton	1871	1,643	–	–	–	–	carbon or plat. with broken cinders.
Lake	1871	2,219	zinc.	bichr. pot., lime, H_2SO_4.	–	–	carbon.
Newton	1871	2,759	zinc.	bich. and nit. pot.	–	–	carbon.
Lake	1871	3,366	zinc.	water.	–	sulp. merc. bl. ox. mang.	platinum.

GALVANIC BATTERIES. LIST OF BRITISH PATENTS (*Continued*).

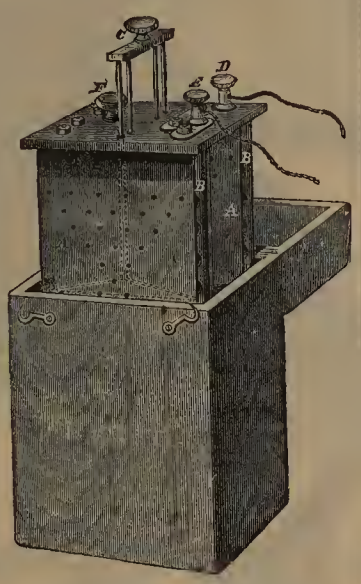
Name.	Date.	Number.	Positive.		Partition.	Negative.	
			Metal.	Liquid.		Liquid.	Metal.
Highton	1872	485	zinc.	nitr. sod.	–	salt of amm. & bi-tart pot.	copper.
Graham	1872	807	zinc.	sulp. zinc.	parchment paper.	sulp. cop.	copper or lead.
Figatnee	1872	1,596	ziuc.	feces.	lime or plaster.	–	copper.
Hightou	1872	1,638	zinc.	bisulp. merc.	–	carbon mang. perox. sulp. cop. amm.	carbon sulph.
Owens	1872	3,672	–	–	–	carb. mang. chrom. ac. crys.	carbon.
Weber	1873	1,270	zinc.	chl. amm.	porous cell.	carbon and carburet iron.	iron.
Varley	1873	2,232	zinc.	sulp. zinc and H_2SO_4.	capillary siphon.	sulp. cop.	copper.
Fréret	1873	2,956	zinc.	bichr. pot.	porous cell partly varnished.	sulp. iron.	iron.
Verdeau	1874	3,943	iron wire.	H Cl.	porous cell.	monohydrate sulp. ac. urine nitric acid.	coke.
Bennett	1874	1,255	zinc.	sod. and pot. hydrate.	diaphragm.	caustic soda.	graphite.
Smith	1874	3,222	zinc.	alkaline chlo. and hydrates.	–	perox. mang. –	carbon.
Clark	1874	3,420	zinc.	amm. salt.	–	hydrated ses-qui-ox. iron.	–
Bonneyville	1874	4,453	–	sulp. acid, sulp. pot.	–	–	–
Elcock	1875	807	–	–	–	–	clay and saw-dust charred.
Bennett	1875	1,169	zinc.	hydrate or protox. pot.	–	carb. mang. nitr. cobalt. pyrogallic ac.	pt. c. au co. ag. ni. fe.
Cerpaux	1875	4,289	zinc.	urine, Na. ch.	wood; sand.	–	copper.
Darkin	1876	52	–	–	–	bichr. pot.	broken graph.
Lake	1876	524	zinc.	–	paper, felt. cloth, tinder.	sulph. cop.	copper.
Pulvermacher	1876	1,900	zinc.	pulv. salt of amm.	carbon vessels.	–	platin. black.
Pulvermacher	1876	3,782	zinc.	salt.	parchment paper.	perox. mang. chl. of silver or chl. plati.	carbon.
Jablochkoff	1877	492	–	–	–	fused nitr. sod. or pot.	carbon.
Brain	1877	1,116	iron.	H. cl. chl. am.	iron ore in flannel bag paraffiued.	acid.	carbon.
Varley	1877	1,702	zinc.	H_2SO_4.	porous cell.	granular graphite oxide mang.	carbon.
De Sussex & Brasseur	1877	2,194	zinc.	sea water.	–	–	carbon.
Watteville	1877	2,313	zinc, merc.	–	–	bichr. pot. ox. iron ag. cl.	carbon.
Arns	1877	2,892	zinc.	bichr. pot	hard sandstone.	–	–
Coxeter	1877	2,997	zinc.	–	water-proof fabric.	powd. carbon. perox. mang.	copper.
Roberts	1877	4,803	zinc 8, merc. 1.	–	–	–	–
Wilson	1878	719	zinc.	Na. cl.	sand. chlorates, pot. nitr., ox. mang., in porous cell.	H_2So_4.	carbon.
Grabinger	1878	1,522	–	sulp. amm.	–	pulv. mang.	–
Fuller & Higgins	1878	3,367	amag. iron.	–	–	–	–
Adams	1878	3,713	zinc.	Na. cl.	porous cell.	chl. lime.	carbon.
Wilson	1878	4,348	iron.	nitr. and sulp. sod.	–	–	–
Slater	1879	477	nickel.	acid.	sesquicarb. of amm in porous cell.	sulp. nickel and amm.	carbon.
Howell	1879	1,015	zinc, merc.	amm. hydro. sulp.	sulp. or nitr. acid in porous cell.	white mang. perox. mang.	charcoal.
Carlson	1879	2,905	zinc.	chl. amm. or bichr.	paper, felt, flannel.	–	copper.
Morgan & Brown	1879	3,410	zinc.	vinegar.	–	–	iron filings, graphite.
Anderson	1879	3,436	ziuc.	H_2SO_4.	–	oxal. ac. bichr. pot. aud acid or salt.	carbon.
Imray	1879	3,858	zinc.	bichr. pot.	water in porous cell.	acid.	carbon.
Gutensohn	1879	3,943	–	–	–	sulp. nitr. chl. or chrom. tin.	
Anderson	1879	4,346	–	–	–	sulphur H cl. perox. mang.	

Gal-va'no Caus'tic. (*Electricity.*) An electro-cautery. See p. 179, *supra.*

Gal-va'no-cau'te-ry Bat'te-ry. (*Surgical.*) For performing cautery by means of the heated platinum wire.

Fig. 1128 is Dr. Dawson's depolarizing battery, which is composed of two cells, in each of which are two positive (zinc) and one negative (platinum) plates, all measuring 4½″ by 6″. The zincs (*A*) are perforated, and adjusted ½″ apart, and between them a platinum plate is placed and held in position by uprights (*B*). On each side of the platinum plates are hard rubber or celluloid pumps or agitators (*C*), worked by means of a small knob. *D* and *E* are the connecting screws, and *F* a knob for lifting the elements out of the cells. The battery requires 2½ piuts of fluid, the action being prolonged by the moving up and down of the pumps (*C*), more or less quickly, according to the intensity of the heat desired. By this action the old and exhausted fluid between the plates is thrown out through the perforations, and fresh fluid is made to take its place.

Fig. 1128.



Galvano-Caustic Battery.

See Cautery Electrode.

See also *Dr. J H. Thompson's* report ou Group XXIV., vol. vii., "*Centennial Exhibition Reports,*" p. 53 *et seq.*

Gal-va-nom'e-ter. An instrument for measuring the force of an electric current.

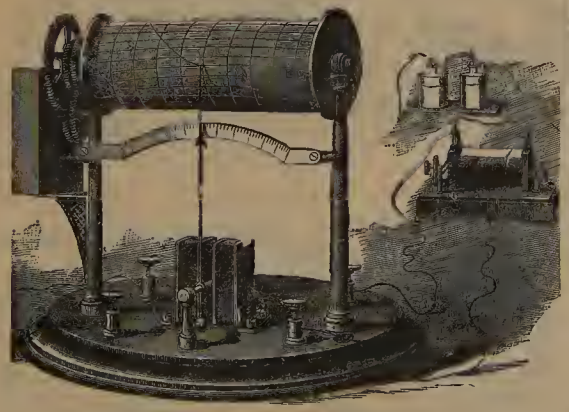
The reflecting galvanometer of Sir William Thomson is used in working submarine cables. In the astatic form it is used as a receiving instrument, placed in a box or curtained apartment, and the receiver calls off each word to an attendant who writes it down. The spot of light wanders over the scale in an apparently aimless manner, but the operator, by practice, interprets the motions.

The *siphon recorder* is a substitute for the reading of the vibratory pencil of light.

The recording galvanometer of Hopkins, shown in Fig. 1129, proceeds by the application of a disruptive spark from an induction coil.

The helixes are wound with rather coarse wire (No. 22). The needle is astatic, the inner member swinging in the central opening in the helixes in the usual way, the outer member being located behind the helixes. The arbor supporting the ueedle has very delicate pivots, and carries a long aluminium index, which is counterpoised so that it assumes a vertical position when no current passes through the helixes, and the needle is unaffected by terrestrial magnetism.

Fig. 1129.



Recording Galvanometer.

The upper end of the index swings in front of a graduated scale, and is prolonged so as to reach to the middle of the cylinder carrying a sheet of paper upon which the movements of the needle are to be recorded. This cylinder is of brass, aud its journals are supported by metal columns projecting from the base upon which the other parts of the instrument are mounted. The scale is supported by vulcanite studs projecting from the columns, and to one of the latter is attached a clock movement provided with three sets of spur wheels, by either of which it may be connected with the arbor of the cylinder. One pair of wheels connects the minute-hand arbor of the clock with the cylinder, revolving the cylinder once an hour; auother pair of wheels connects the hour-hand mechanism with the cylinder, so that the latter is revolved once iu twelve hours; while a third pair of wheels give the cylinder one revolution in six days.

This instrument is designed especially for making prolonged tests of different batteries in order to determine the characteristics. It is provided with four binding posts, one of which connects the wires of the batteries under test with the helixes. The other binding posts are connected respectively with the posts supporting the needle aud with the journals of the recording cylinder. These posts receive wires from an induction coil capable of yielding a spark from ⅛″ to ¼″ long.

The induction coil is kept continuously in action by two Bunsen elements and a stream of sparks constantly pass between the elongated end of the index and the brass cylinder, perforating the intervening paper and making a permanent record of the movement of the needle.

The paper upon which the record is made is ruled in one direction into degrees and in the other into hours and minutes. Refer to: —

Internal current, *Cooke*	* "*Engineering*," xxviii. 201.
Mirror, *Delafield* . . .	* "*Scientific American Sup.*," 2003.
Deprez	* "*Scientific American Sup.*," 3837.
Edison	* "*Scientific American*," xli. 239.
Astatic, *Faraday* . .	* "*Engineering*," xxiii. 91.
Reflecting, *Thomson* .	* "*Engineering*," xxiii. 62.
	* "*Scientific American Sup.*," 205.
Lantern, *Nipher* . . .	"*Scientific American*," xxxiv. 129.
Recording, *Hopkins* .	* "*Scientific American*," xliii. 271.
Paper on	* "*Engineering*," xxiii. 61, 91.
For testing lightning-rods, *Büchner* . .	"*Technologiste*," xxxvii. 327.

Gal-va'no-plas-tique'. 1. (*Bronze.*) A particular kind of bronze work produced by depositing a heavy coating of bronze by the galvanic process upon a plaster of paris model, and afterward removing the model.

2. (*Glass.*) M. Alexander's process rests on the application of electro-metallurgy to the decoration of glassware, mirrors, etc., either for the exterior or interior decoration of houses, furniture, etc.

The substance which serves for tracing the design on the glass is a metallic paste of good conducting power, mixed with a solvent and thinned with an essential oil. The design once executed on the glass, the latter is submitted to the action of fire in either a muffle or a furnace, and is not withdrawn until perfectly cold.

The glass is then immersed in a metallic bath and a galvanic current passed over it; by this means the metal in suspension in the bath is precipitated on the design. The glass is withdrawn as soon as the coating becomes as thick as required. Finally, if necessary, the metallic design is finished up by chiseling or other means, and is left thus; or, indeed, another layer of a like or different metal may be deposited on it. —"*Moniteur de la Céramique.*"

See also Electrotype.

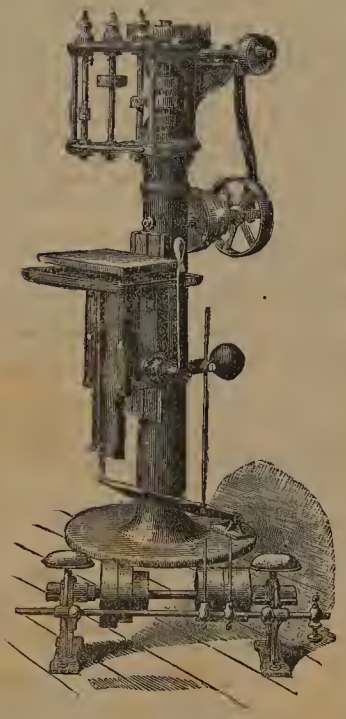
Laboulaye's "*Dictionnaire des Arts et Manufactures*," caption "*Galvanoplastic*," vol. ii.

"*Scientific American*" . . . . . xxxix. 136.

Gang. (*Sawing.*) *Round* and *live* gang are synonymous, one being the Eastern and the other the Western term for the same thing. It means such an arrangement of the saw-mill as causes the whole log to be cut up into boards at one operation. A *slabbing* gang is one by which from only the two sides of a log slabs are cut off, while the middle part remains as a thick beam. When the log is

carried forward on a carriage termed a *saddle*, it is called a *saddle slabber*. After a beam has been flattened by passing through the *slabber* gang, it can be sawn into boards of equal width in the *flat* gang, when it will be straighter than if sawn only on a *round* or *live* gang. A *pony* is a single or small flat gang, used for sawing thin boards out of the best quality of timber.

Fig. 1130.



Gang Drill.

Gang Drill. A machine-tool having a number of vertical drills in a single head, each with its own belt and pulley from a common shaft, and with speed pulleys common to the gang.

The Pratt & Whitney gang drill is shown in Fig. 1130, without bands to the drill spindles, which are three in number. The counter shaft is shown detached, lying in inverted position upon the floor. The bench has vertical adjustment, and a certain amount of traverse by means of a treadle.

* *Thurston's "Vienna Report,"* ii. 223.

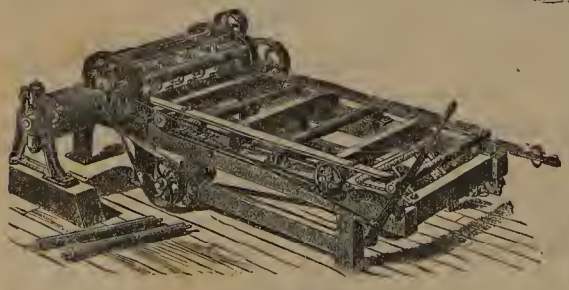
Gang Edg'er. A machine with a number of circular saws on a common mandrel, and adjustable as to relative distance, so as to split wide planks, etc., into boards or scantling of the desired width. The saws are from 3 to 6 in number.

In the Lane & Bodley gang edger the saws are not held on the mandrel by grooved collar and fork but by guide fingers on opposite sides of the saw; the guides have adjusting screws at the opposite ends of a yoke.

The stuff is fed between upper and lower rolls, the former being adjustable to admit varying thickness of stuff.

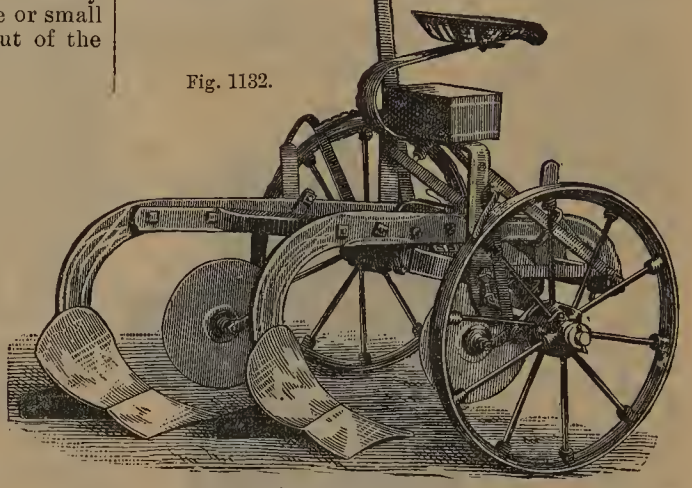
* "*Manufacturer & Builder*" . . . xi. 53.

Fig. 1131.



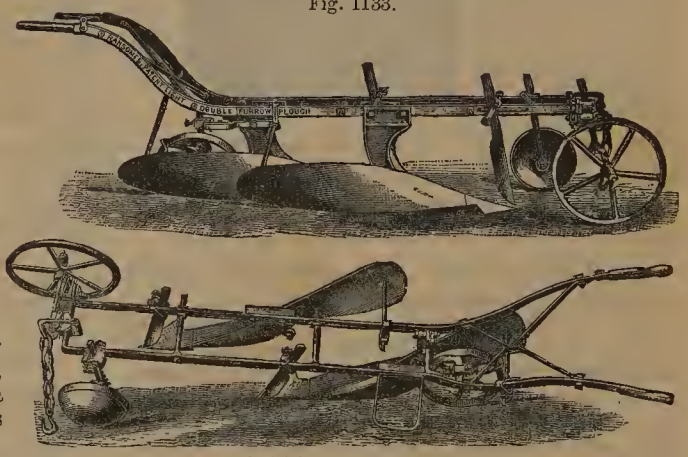
Gang Edger.

Fig. 1132.



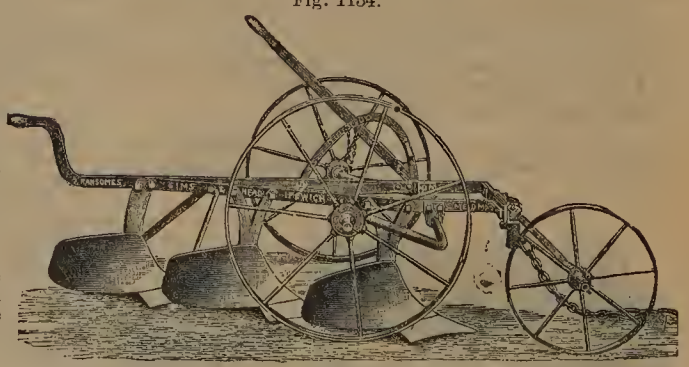
Moline Gang Plow.

Fig. 1133.



British Gang Plow.

Fig. 1134.



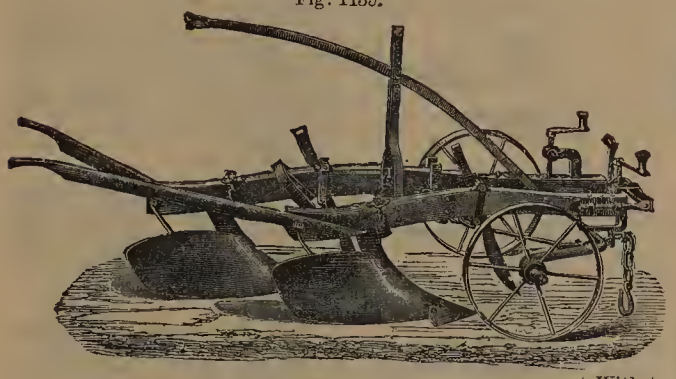
Ransome's Multiple Plow.

Gang Plow. A plow with two or more shares and mold-boards.

That shown in Fig. 1132 is the Deere gang-plow (Moline), which is all of iron and steel.

The plows are rigidly connected, rock upon the axle, and are operated by one lever. It is run by either three horses abreast, or four horses strung out in pairs, or any larger number in pairs, one wheel in the furrow. The plow is operated entirely by one lever, which locks the plows in the ground at various depths; and the same lever, in connection with a lug on the hub, lifts the plow clear of the ground for turning at the ends, without any effort of the operator. The tongue and clevis are attached to the beams by a swivel bolt,

Fig. 1135.



Meixmoron de Dombasle's Gang Plow.

giving it a free vertical motion, relieving the horses' necks of all pressure, and affording a natural draft from the ends of the beams, and from the end of the tongue.

It received a gold medal at the Paris Exposition of 1878, after the trial at Marmont, near Paris, the same summer.

Fig. 1133 is a British gang-plow, shown in two positions; the lower one illustrates the means for allowing it to travel on the surface of the ground without penetrating, in moving to and from the field and turning at the ends of the lands. Of its three wheels, one is for gage of depth; one to run in the furrow and support the plow behind the share, reducing the friction; and the third is only used to support the fore end of the plow in turning, while the rear end is supported by the stirrup-shaped piece.

Fig. 1134 is Ransome's multiple plow with three shares. The body is of the usual British type, an open frame of bar iron to the beams of which the plow standards are bolted. A single handle projects at the rear, and the depth of the furrows, or the completc removal of the plows from the soil is accomplished by a lever which governs the crank-axle of the carrying wheels, elevating or depressing the plow frame and bodies simultaneously.

Fig. 1135 is the *bisoc* of Meixmoron dc Dombasle, of Nancy, France. It is composed of two plows attached to a single frame (*avant train*), which is supported by wheels, and carries the clevis, which has adjustments for land and for depth. The axle of the fore-carriage carries a long lever, projecting upward and rearward, and by the depression of the upper end the crank axle is rotated, throwing the wheels forward and lifting the front end of the plow, so that the shares leavc the ground. This is used in turning at the end of a furrow, and also as a means of setting the plow for any given depth, pins on the vertical post holding the lever at any inclination. It received a gold medal at the trials at Marmont, near Paris, Exposition of 1878.

American, British, and French, Paris, 1878 . . . . . * *Knight's Report*, "*Paris, Expos. Repts.*," v. 28–49.
* "*Sc. Am.*," xxxix. 163.
Trials, Dynamometrical table . * "*Sc. Am.*," xxxix, 180.
Steam (4-furrow), *Fowler*, Br. . * "*Eng'ing*," xxii. 485.
Howard, Br. . . . . * "*Eng'ing*," xxvi. 471.
* "*Sc. Am.*," xxxviii. 409.
Ransome, Br. . . . . * "*Eng'ing*," xxvii. 436.
Stanley . . . . . * "*Sc. Am.*," xlii. 306.

Gang Press. One for operating upon a pile or row of objects in a gang.

Seen in some forms of oil and stearine presses; see also FILTER PRESS, where the cases are in gangs. See also CHEESE PRESS; HOT-PRESS; HYDRAULIC PRESS.

Gang Saw. Several saws in a frame or on a spindle, acting simultaneously, either gate or circular. See Fig. 2157, p. 942, "*Mech. Dict.*" See GANG.

"The vast systems of roller gang mills in America have no parallel in the world." — *Richards.*

"A circular saw for edging and squaring, with a gang for slitting the stocks at one operation, is the equipment of a modern saw-mill. This outfit is, of course, duplicated many times in a large mill. At St. Anthony, in Minnesota, there are as many as 12 such mills in a single establishment."

"The speed of the teeth, or the number of teeth that operate in a given time, is the exponent of the performance of saws. The rate of feed varies with the timber; and saw-mills, like other machinery, are governed by mechanical laws, which admit of theoretical demonstration.

"A single reciprocating saw of 30″ stroke, 180 a minute, has a cutting movement of 450′ in the same time. In a gang of 20 saws, making in a minute 150 strokes of 24″, the cutting movement in the aggregate is 6000′ per minute." — *Richards.*

Marston . . . * "*Scientific American*," xxxvi. 6.
Snyder . . . * "*Manuf. & Builder*," xi. 175.

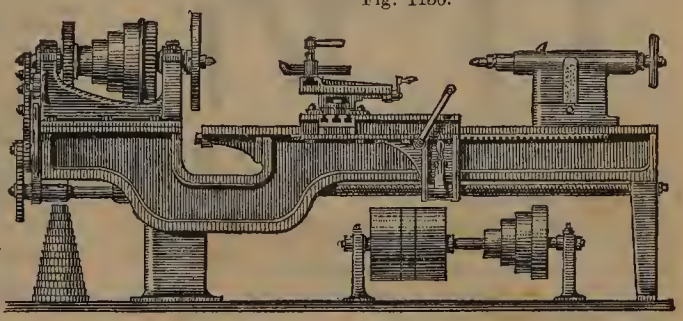
Gan'try. (*Gawntree.*) A scaffolding or frame, carrying a crane or other structure.

See TRAVELING CRANE, Fig. 6623, "*Mech. Dict.*"
OVERHEAD CRANE, Fig. 3451, "*Mech. Dict.*"
STEAM CRANE, Fig. 5652, "*Mech. Dict.*"

Gap'-bed Lathe. One with an opening in the bed or shears to allow a larger object to be turned. Technically: to increase the *swing*.

With traveling crane, *Watson* . * "*Engineering*," xxvii. 154.
* "*Iron Age*," xx., Aug. 9, p. 1.
* "*Sc. Am.*," xxxvi. 255.

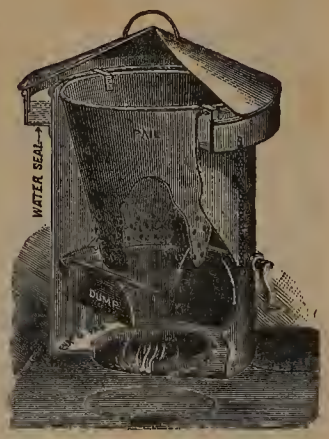
Fig. 1136.



Gap-bed Engine Lathe.

Gar'bage Burn'er. A self-sealing pail for holding kitchen garbage. It is suspended within an outer cylinder adapted to be placed on a stove, so that the garbage may first be dessicated and then dumped into the stove.

Fig. 1137.



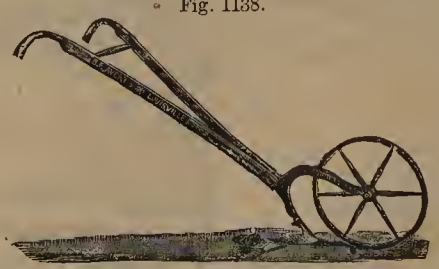
Garbage Pail.

Pavement garbage box, *Jonas*, Br., * "*Engineer*," xlix. 190.
Garbage furnace, *Foote*, * "*Scientific American*," xl. 198.

Gar'den En'gine. A pump for watering the garden. See AQUAPULT, HYDRONETTE, IRRIGATOR, etc.

Pump, *Bickford* . . . . * "*Iron Age*," xxi., April 11, p. 5
Sprinkler, *Hodel & Stauber* * "*Sc. American*," xxxix. 370.

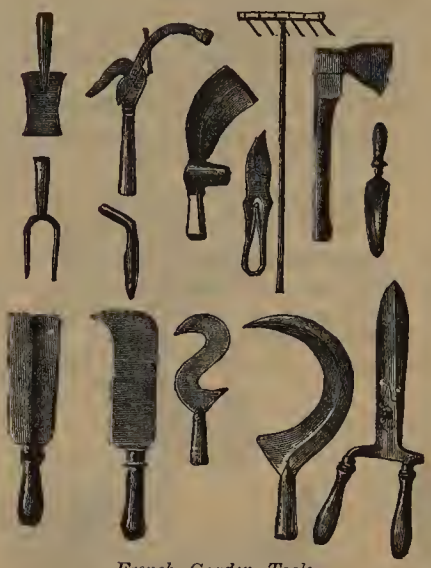
Fig. 1138.



Garden Plow.

Gar'den Net. One placed over fruit trees or vines to guard against depredation by birds.

Fig. 1139.



French Garden Tools.

Gar'den Plow. A small hand plow for cultivating vegetables in rows. It has a variety of hoes. See Fig. 1138.

Gar'den-ers' Tools. Fig. 1139 shows a variety of French garden tools: for digging, cultivating, trimming, pruning, and transplanting.

Gar'den Syr'inge. See AQUAPULT; IRRIGATOR; SPRINKLER, etc.

Gas. See under the following heads:—

Air-gas apparatus.
Back log.
Bye-pass.
Carburetor.
Coke fork.
Coke manufacture.
Compensator.
Consumers' test meter.
Double-gate valve.
Exhauster.
Exhauster governor.
Fire-damp detector.
Fire-damp photometer.
Fire-damp test.
Gas absorber.
Gasalier.
Gas analyzer.
Gas and coke furnace.
Gas apparatus.
Gas bag.
Gas bath.
Gas blow-pipe.
Gas burner.
Gas burner regulator.
Gas compensator.
Gas compressing pump.
Gas condenser.
Gas detector.
Gas drip pump.
Gas economizer.
Gas engine.
Gas exhauster.
Gas exhauster governor.
Gas-fitter's torch.
Gas furnace.
Gas generating furnace.
Gas governor.
Gas grate.
Gas heater.
Gas holder.
Gas indicator.
Gas lantern.
Gas lighter.
Gas light governor.
Gas lighting.
Gas lighting torch.
Gas liquefaction apparatus.
Gasing machine.
Gas machine.
Gas-main drill.
Gas making.
Gas meter.
Gas meter cock.
Gas oven.
Gas pipe.
Gas pipe connection.
Gas pipe valve.
Gas pressure gage.
Gas process.
Gas producer.
Gas prover.
Gas purifier.
Gas range.
Gas regulator.
Gas soldering apparatus.
Gas stove.
Gas tar pump.
Gas tester.
Gas trap.
Gas tube vise.
Gas valve.
Gas verifier.
Grisoumeter.
Illuminating power meter.
Jet photometer.
Nitrogen gas apparatus.
Nitrous oxide apparatus.
Overflow gage.
Oxygen gas apparatus.
Ozone apparatus.
Ozonizer.
Photometer.
Pressure and vacuum gage.
Pressure and vacuum register.
Red litmus paper.
Retort furnace.
Scrubber.
Siphon gage.
Specific gravity apparatus.
Station meter.
Steam jet exhauster.
Sulphur and ammonia test.
Tell tale.
Tempering Gas heater.
Test meter.
Thermometer.
Turmeric paper.
Water gas.

Refer to the following:—

Absorber, *Gore* . . . * "*Scientific American Sup.*," 2031.
Analyzer, *Goodwin* . . * "*Scientific American Sup.*," 1767.
"*Scientific American Sup.*," 2757.
Orsat, Fr. . . . . * "*Scientific American Sup.*," 3983.
Schwackhoefer, Austr. * "*Engineer*," xlv. 95.
Apparatus, *Lowe* . . . * "*Min. & Sc. Press*," xxxvii. 137.
* "*Eng. & Min. J.*," Nov. 20, 1875.
Chandler . . . . . "*Iron Age*," xxvii., Jan. 13, p. 24.
Melville . . . . . * "*Amer. Gas-light Jour.*," July 3, 1876, p. 9.
Balloon, *Giffard*, Paris, 1878 . . . . . * "*Scientific American Sup.*," 2430.
Battery, *Grove* . . . * "*Scientific American Sup.*," 2526.
Paper by *Niaudet* . . "*Galv. batteries*," Am. trans., 242.
Burner . . . . . * "*Scientific American Sup.*," 2772.
McGeorge . . . . * "*Scientific American*," xliii. 312.
Argand, *Sugg*, Br. . * "*Engineer*," xlvii. 106.
And lanteru, *Sugg*, Br. * "*Engineering*," xxvii. 142.
* "*Scientific American Sup.*," 3963.
Heating, *Ehret* . . . * "*Scientific American Sup.*," 460.
Paper on, *Pattinson* . "*Scientific American Sup.*," 291.
Regulator . . . . "*Scientific American Sup.*," 2291.
Self-lighting.
Stockwell . . . . * *Telegraphic Journal*," vi. 243.
* "*Scientific American*," xxxiv. 211.
* "*Engineer*," xliii. 170.
Self regulating.
McMillan . . . . * "*Scientific American*," xxxv. 4.
Check . . . . . * "*Engineer*," xlvi. 439.
Cloth, Gas tight, *Hirzel*. "*Iron Age*," xxii., Aug. 1, p. 19.
"*Scientific Amer.*," xxxix. 338.
Coke oven . . . . . "*Scientific American Sup.*," 107.
Compressing pump. . . * "*Engineering*," xxxiii. 397.
Bouvet . . . . . * "*Scientific American*, xxxviii. 73.
Brush . . . . . * "*Scientific American Sup.*," 300.
Condenser, *Cross* . . . * "*Scientific American*," xxxix. 22.
Pelouse & Andouin . * "*Engineering*," xxv. 489.
Herring & Floyd . . * "*Am. Gas-light Jour.*," July 3, 1876, p. 13.
Mackenzie . . . . * "*Am. Gas-light Jour.*," July 3, 1876, p. 12.
Engine, Paper on . . . * "*Manufact. & Builder*," x. 188.
* "*Scientific American Sup.*," 1507.
Armengaud . . . . "*Technologiste*," xl. 84-90.
Barber . . . . . "*Van Nostrand's Mag.*," xx. 148.
Bischoff . . . . . "*Van Nostrand's Mag.*," xx. 148.
"*Iron Age*," xxii., Feb. 6, p. 11.
* "*Scientific American*," xxxix. 390.
* "*Engineering*," xxvi. 331.
Brayton . . . . . * "*Vienna Exp. Rept.*," iii. A., 165.
* "*Scientific American Sup.*," 339.
Clayton, Br. . . . . * "*Engineer*," xlviii. 25.
Clerk, Br. . . . . * "*Engineer*," xlviii. 24.
Gilles, Ger. . . . . * "*Scientific American Sup.*," 691.
Gilles & Humboldt . * "*Scientific Amer.*," xxxvii. 178.
* "*Engineer*," xliv. 39.
Hugon, 1858 . . . "*Vienna Exp. Rept.*," iii. A., 167.
* "*Van Nostrand's Mag.*," xx. 148.
Hurd, Br. . . . . * "*Engineering*," June 25, 1880.
* "*Scientific Amer.*," xxxviii. 356.
Labon, 1799 . . . . "*Van Nostrands' Mag.*," xx. 148.
Langen, Otto . . . * "*Polytechnic Review*," May, 1876.
* "*Scientific American Sup.*," 420.
Leavitt . . . . . "*Vienna Exp. Rept.*," iii. A., 163.
Lenoir . . . . . "*Vienna Exp. Rept.*," iii. A., 163.
"*Van Nostrand's Mag.*," xx. 148.
Mead, 1794 . . . . "*Van Nostrand's Mag.*," xx. 148.
Otto . . . . . "*Van Nostrand's Mag.*," xx. 148.
* "*Scientific American Sup.*," 339; * 1853, * 2323.
* "*Scientific Amer.*," xxxviii. 195; xxxix. 386.
* "*Iron Age*," xxii., Oct. 31, p. 1.
* "*Polytechnic Rev.*," May 1876, 49.
* "*Engineering*," xxvii. 565; * xxvi. 155.
"*Van Nostrand's Mag*," xviii. 66.
"*Mining & Sc. Press*," xxxvii. 211.
Otto-Langen . . . * "*Vienna Exp. Rept.*," iii. A., 168.
"*Van Nostrand's Mag.*," xx. 148.
"*Deschanel's Nat. Phil.*," i. 491.
* "*Eng. & Min. Jour.*," xxvi. 205.
Papin, 1688 . . . . "*Van Nostrand's Mag.*," xx. 148.
Ravel . . . . . "*Van Nostrand's Mag.*," xx. 148.
Simon, Br. . . . . * "*Scientific American Sup.*," 2889.
"*Van Nostrand's Mag.*," xx. 148.
* "*Engineer*," xlvii. 43.
Street, 1794 . . . . "*Van Nostrand's Mag.*," xx. 148.
Exhauster, Beale, Br. . * "*Engineer*," xli. 227.
Root . . . . . * "*Am. Gas-light Jour.*," July 3, 1876, p. 17.
Prosser & Ray . . . * *Ibid.*, p. 11.
Smith & Sayre . . . * *Ibid.*, p. 11.
Mackenzie . . . . * *Ibid.*, p. 11.
Körting . . . . . * "*Eng. & Min. Jour.*," xxi. 464.
Exhauster governor, *Allen* * "*Scientific American*," xli. 15.

Exhaust gov., *Goodwin* * "*Am. Gas-light Jour.*," July 3, 1876, p. 4.
Fuel, gas as a, *Strong* . "*Sc. American*," xxxix. 346.
"*Scientific American Sup.*," 2833.
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* "*Scientific American Sup.*," 4000.
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* "*Iron Age*," xxv., March 11, p. 1.
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* "*Engineer*," l. 191.
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* "*Scientific American Sup.*," 4000.
* "*Engineer*," l. 192.
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* "*Iron Age*," xxv., March 25, p. 7.
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* "*Iron Age*," xx., July 12, p 5.
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* "*Scientific Amer.*," xxxviii. 137.
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Emerson . . . . . "*Scientific Amer.*," xxxix. 168.
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Still . . . . . * "*Scientific American Sup.*," 914.

Regulator	* "*Manufact. & Builder*," x. 181.
Adams	* "*Scientific American*," xxxix. 306.
Borrodaile	* "*Engineer*," l. 218.
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Martin	* "*Scientific American*," xxxvi. 262.
Schooley	* "*Engineer*," xlviii. 153.
Stott, Br.	* "*Engineer*," xlix. 210.
Retorts, setting	* "*Scientific American Sup.*," 348.
Vertical, *Bennie*, Br.	* "*Engineer*," xlii. 176.
For machines,	
Kannel & Towsley	* "*Scientific American Sup.*," 2.
Saver, *de Palos*	* "*Scientific American*," xlii. 164.
Shale, from	"*Scientific American*," xxxiv. 112.
Tar pump	* "*Scientific American Sup.*," 1412.
Tester	* "*Scientific American Sup.*," 2757.
Edinburgh	"*Scientific American Sup.*," 44.
Giroud	* "*Manuf. & Builder*," viii. 262.
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	* "*Engineer*," xlv. 240.
Newman & Duesbury, Br.	* "*Scientific American Sup.*," 2177.
New York	"*Scientific American*," xxxvii. 163.
Orsat, Fr.	* "*Scientific American Sup.*," 3983.
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Schwackenhoefer, Austr.	* "*Engineer*," xlv. 95.
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	* "*Scientific American Sup.*," 1552
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Anderson, Br.	* "*Engineering*," xxviii. 43.
Patterson, Br.	* "*Engineering*," xxviii. 313.
Saville	* "*Scientific American Sup.*," 1026.
Well, "Delamater"	"*Scientific American Sup.*," 1267.
Papers on	"*Sc. Amer. Sup.*," 90, 439, 757.
Pennsylvania	"*Scientific American*," xxxvi. 196.
Wyandotte	"*Scientific American Sup.*," 1427.
Wood, from	"*Min. & Sc. Press*," xxxvii. 98, 115.

See *Bowditch*, "*Analysis, Technical Valuation, Purification and Use of Coal Gas.*"
Colburn's "*The Gas-works of London.*"
Perkin's "*Gas & Ventilation.*"

Gas'a-lier'. An arrangement of standard or drop, with branches and burners, adapted for the consumption of illuminating gas. The word is a clumsy imitation of *chandelier*.

Gas An'a-ly'zer. An instrument for determining the presence and quantity of the gases obtained by the destructive distillation of coal.

The following gases are produced: —

Ammonia ($N H_3$).	Acetylene, etc. ($C_2 H_2$).
Sulphureted hydrogen ($S H_3$).	Carbonic oxide ($C O$).
Carbonic acid ($C O_2$).	Light carbureted hydrogen ($C H_4$).
Air, or oxygen and nitrogen.	
Bisulphide of carbon ($C S_2$).	Hydrogen (H.)
Olefiant Gas ($C_2 H_4$).	

The first four of these gases on the list, although often present in well-made gas, are generally considered impurities, and by right should not be there.

The first analysis is qualitative to ascertain presence, to determine the order of precedence in the removal. The apparatus admits the gas to be bubbled up through the liquid charged with reagent.

The following reagents are used in the various tests: —

1. Dilute sulphuric acid.
2. Solution nitrate silver.
3. Solution arsenious acid.
4. Solution iodine.
5. Bromine.
6. Solution caustic potassa.
7. Solution pyrogallate potassa.
8. Solution sub-chloride copper in hydrochloric acid.
9. Lime water.
10. Red litmus water.
11. Solution acetate lead.

See "*American Gas-light Journal*," reproduced in part in * "*Scientific American Supplement*," 1767.

Gas and Air Mix'er. An instrument designed to mix a given proportion of air with gas made from petroleum, or its residuums, or tar, oil, rosin, or any rich hydrq-carbon, so as to produce the best results from the combustion of either, through ordinary gas burners. Gas 60, air 40, is the usual proportion.

Gas and Coke Fur-nace. Many attempts have been made to obtain at the same time and operation gas for lighting and coke for metallurgical operations, by coking the coal in closed furnaces, from which the gas was conducted to the hydraulic main.

Pauwels, in 1849, established an apparatus of this kind at Ivry, in the suburbs of Paris, and his plan was subsequently improved by Pératé, resulting in the arrangement now used at Vilette, Paris, and elsewhere. See Plates XVI., XVII.

The distillation chamber is constructed of brick, and is of sufficient size to contain 6000 kilos of coal. It is open at each extremity, and the sole is horizontal. The coal is brought in wagons, which run on rails placed above the battery of parallel chambers, in order to be discharged into the chamber at an opening provided in the arched ceiling. Workmen spread it evenly over the floor to the height of the springing of the arch, equal to 0.60 to 0.70 m. of depth.

The sole of the furnace is heated by the circulation of flame beneath it, and serves, while the chamber is being recharged, as a reservoir of the heat produced during the latter part of the preceding operation. There is but one fire to each chamber.

The chambers are placed side by side and are closed at each extremity by an iron door, working in fixed iron guides on the jambs of the furnace mouth, and luted with fire-clay during the operation.

The gas escapes by a pipe *T*, which pierces the vault and communicates with a general conduit, a hydraulic valve *H* preventing back-lash of gas when the chamber is opened for recharging.

The distillation of a charge, containing 5 or 6 tonnes, occupies 72 hours. When it is terminated, the doors are unclamped, the luting removed, and the hydraulic valve fastened down. The free gas in the chamber escaping around the doors is lighted, and the doors are lifted by means of a winch, which travels on rails above each face of the battery of chambers. These rails are founded on the iron stay-structure of the furnace front.

The coke is removed by a pushing apparatus which, entering at one doorway, — that to the right in the longitudinal vertical section, — crowds the coke out at the other door on to a stone or iron floor which is on a level with the sole of the coke chamber. This floor is subdivided by walls in prolongation of the divisional walls between the respective chambers, and which are about the height occupied by the coke when in the chamber. These walls form a sort of cell for the coke into which it is pushed and where it is smothered by a covering of cinders and allowed to cool for 24 hours.

The figures in Plates XVI., XVII., represent the Pauwels-Pératé system as applied at Villette, Paris.

Fig. 1140 is a vertical transverse section on the line *A' B'*, Fig. 1143, and passing through the axis of the charging hole *G* by which coal is introduced into the chamber *C*. Above it is seen the wagon *W* in which the coal is brought, and which runs upon the rails.

Fig. 1141 is a transverse vertical section following the line *A, B, C, D*, Fig. 1143. It passes through the furnace *F*, and shows the diving flues *V V*, to the flues *X X*, leading to the chimney *Y*, which is common to all the furnaces in the battery. Dampers are placed in the diving flues to regulate the draft.

Fig. 1142 is a front elevation at the end where the coke pusher is operated, the right hand in the longitudinal vertical section.

Fig. 1143 is a vertical longitudinal section through the center of the chamber and the furnace beneath. It shows the entrance conduit *G* for the coal; the pipe *T*, by which the gas escapes from the chamber and the hydraulic valve *H* which isolates the gas conduits from the chamber when the latter is recharging. *W* shows the coal wagon on the track and *W'* an empty wagon on another pair of rails. The winches, *K K*, move on their respective tracks above the front and rear faces of the battery, and serve to lift the heavy iron doors which close the ends of the chambers of distillation.

Fig. 1144, Plate XVII., is a plan passing on a line just beneath the sole of the chamber and above the furnace. It indicates the circulation of the flames under the sole. The draft passes along the center and reverts back along each side, as shown by the arrows at the end of the division walls, *M M*. *V V* are the diving flues leading to the flues *X X* and chimney, *Y*, previously mentioned. The brick pillars *a a* support the sole, like those in the Roman *hypocaustum*, which, in fact, the furnace arrangement much resembles. See Fig. 2629, p. 1160, "*Mech. Dict.*"

Figs. 1145 and 1146 show the coke discharger, the first-named figure being a plan view and the other an elevation. The discharger has two principal portions; the lower one, *P'*, resting upon several pairs of wheels, *R R*, of which one pair only is shown in the views, in order to bring the illustration within reasonable space. By means of these wheels and the rails, *T*, the coke-pusher is brought opposite to any one of

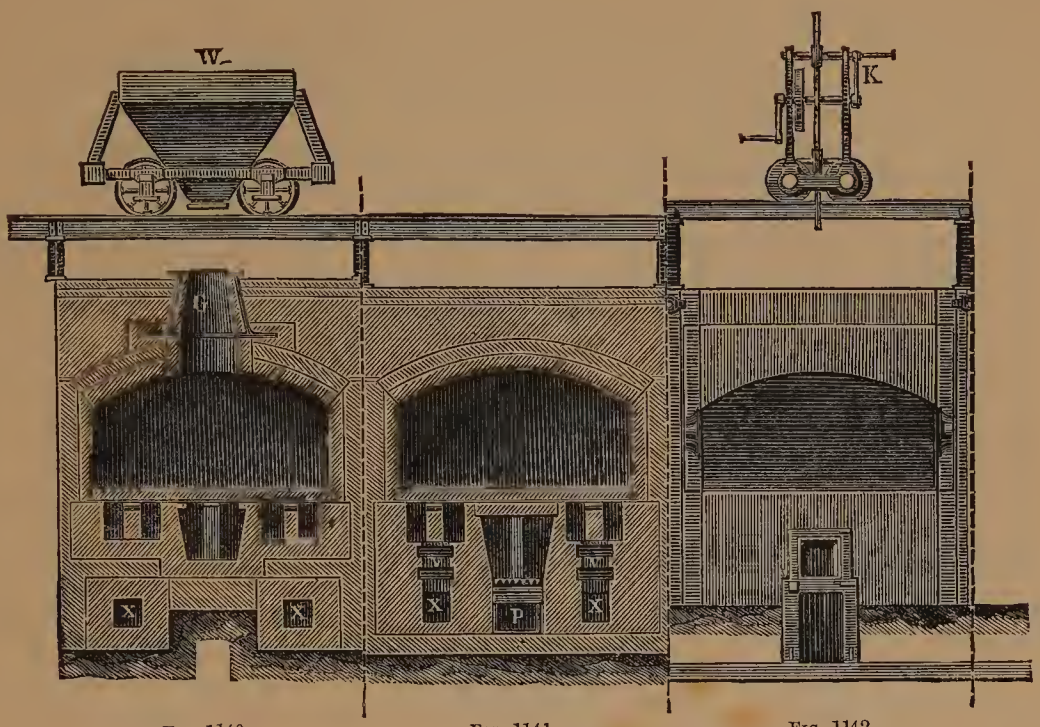

FIG. 1140. *Front Elevation*

FIG. 1141. FIG. 1142. *Transverse Vertical Sections.*

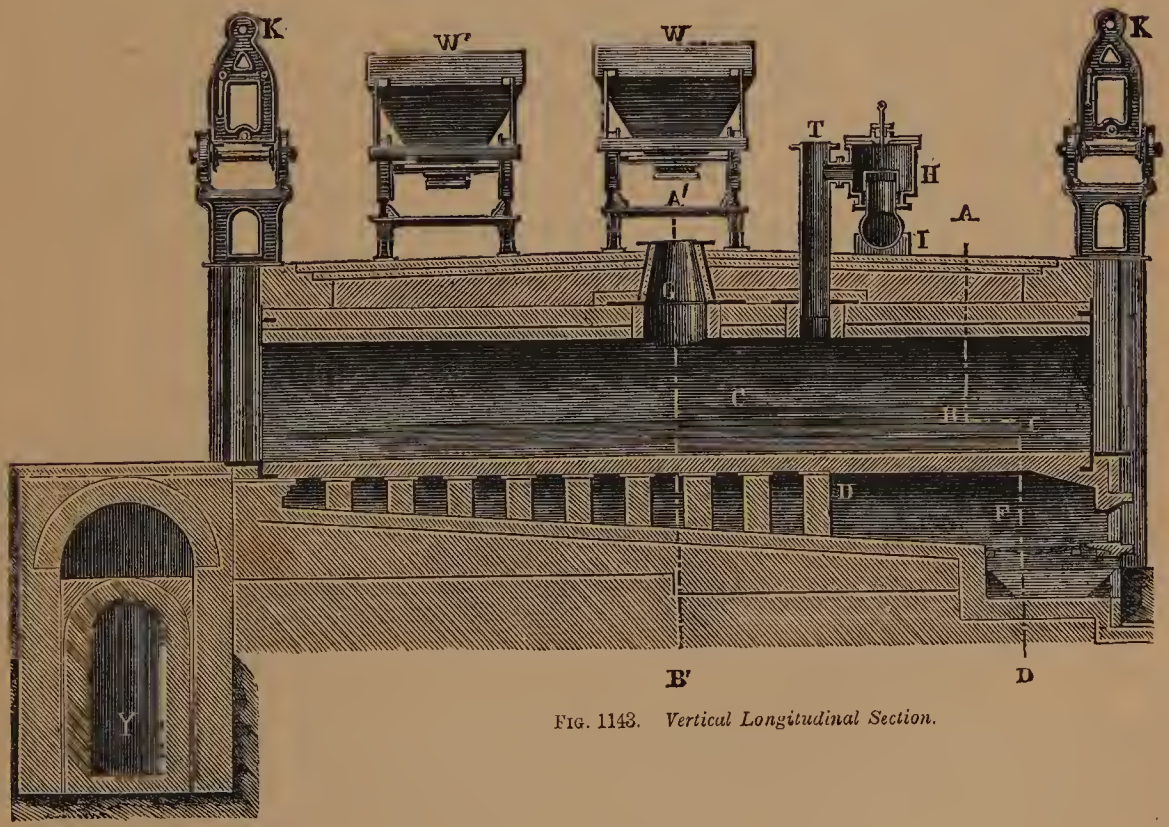

FIG. 1143. *Vertical Longitudinal Section.*

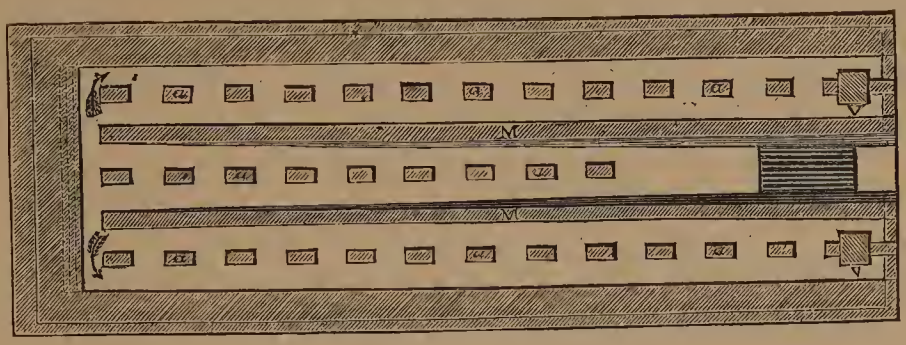

FIG. 1144. *Horizontal Section through Furnace.*

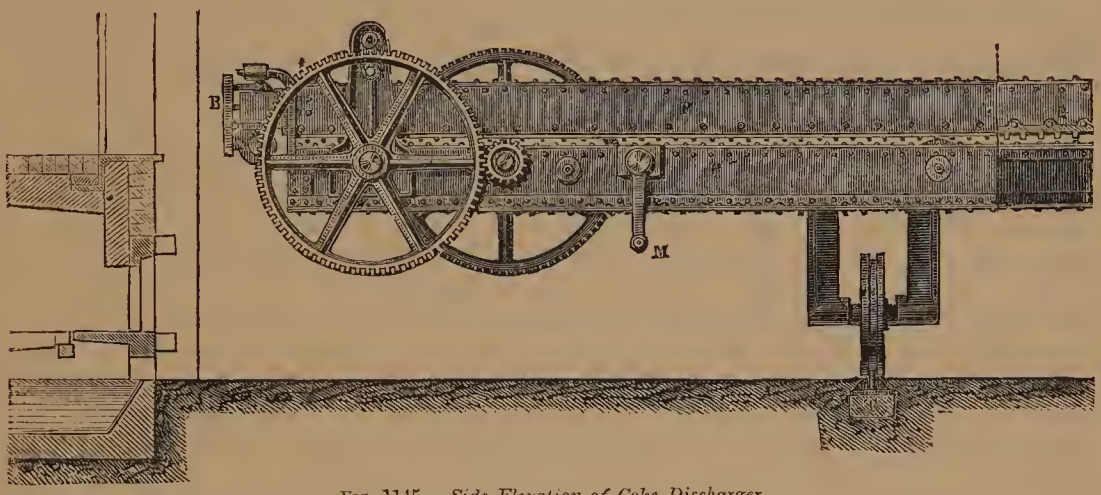

FIG. 1145. *Side Elevation of Coke Discharger.*

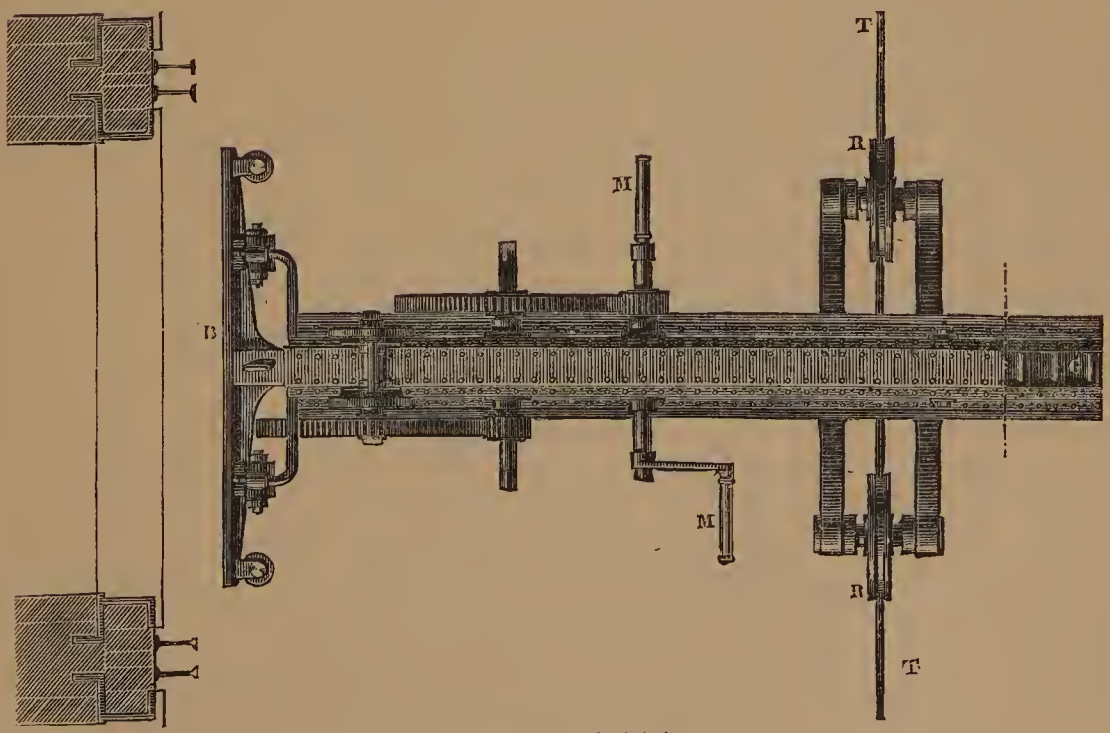

FIG. 1146. *Plan of Coke Discharger.*

PLATE XVII. PAUWEL-PÉRATÉ GAS AND COKE FURNACE, VILLETTE, PARIS *See pages* 378, 379.

the coke chambers, and, the doors of the latter being open, the upper portion, *P*, of the apparatus, armed at the end with a shield, *B*, is projected by means of the cranks, *M M*, and the gearing, acting upon a rack, *G*. The pusher, *P*, slides upon rollers on the carriage, *P'*, and the shield, *B*, has rollers at its ends which guide it in the coke-chamber to prevent its injuring the walls.

The coke oven of McLanahan & Co., Hollidaysburg, Pa., seems to be somewhat on this plan. Each chamber or oven is 22′ × 3′ and 7′ high, and a row of them looks like an arcade. The bottom and sides of the ovens are combustion chambers, in which is burned the gas liberated from the coke. The ovens are closed by iron doors at the ends.

The ovens are charged by hopper-filling trucks, which run on rails above the ovens; two filling holes to each oven aid in distributing the coal. The discharge is effected by a steam ram, which moves to and fro on a railway in front of the ovens. At the end of a long rack is a head which fits the oven, and this is pushed by powerful gearing, and expels the coke at the opposite doorway, the coke being left on the cooling ground at the other side of the oven. The ram being then withdrawn, the doors closed, the covers taken from the filling holes, the oven is recharged before it has had time to cool. The charge of an oven is 8 tons, and it is coked in 72 hours, the time occupied by the ovens at Villette. The produce is 6 tons of coke.

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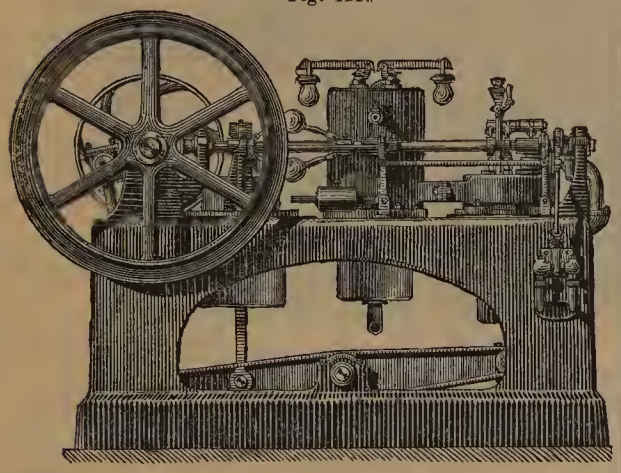
Gas and Steam Mo'tor. A machine operating through the combined forces of compressed gas and steam.

Simon's motor combines air, compressed gas, and steam. The two former are aspirated and compressed in a cylinder, where they are mixed, and whence they pass into the motor cylinder above a jet of gas kept constantly burning. There they burst into flame, burn without explosion, and increas-

Fig. 1147.



Gas and Steam Motor.

ing in volume by heat, act upon the piston. The heat that they contain, on escaping from the cyliuder, is utilized in the production of steam in a generator of special form. This steam, admitted into the motor cylinder at the same time as the mixture of the air and gas, considerably increases in expansive power, and serves at the same time to lubricate the sides of the cylinder.

The cylinder for compressing the gases and the motor cylinder are placed each at one of the extremities of the frame, and are each connected with the opposite ends of a walking-beam situated beneath. At the extremity of the lever, and at the side of the compression cylinder, is attached the crank which actuates the driving shaft. The steam generator is situated in the center, between the motor and compressing cylinders.

In the great variety of motors acting by expansible gases and air, the three — air, gas, and steam — have been combined in numerous ways. The history of the subject has been sketched in GAS ENGINE, pp. 947-949, "*Mech. Dict.*" See also GAS ENGINE, p. 381, *et seq.*, *infra*.

See also GAS, STEAM, AND AIR MOTOR, *infra*.

* "*Scientific American Supplement*" . . . . . 2889.

Gas and Wa'ter-tight Cloth.

A large, smooth piece of so-called gutta-percha paper is placed between two pieces of shirting, and then passed between heated rollers. The outer pieces of shirting combine in the most intimate way with the inclosed gutta-percha to form a material which is impenetrable by gas and water. It may be made still denser and more resistant by being coated on both sides with copal lac. The substance is conveniently flexible, and will remain proof against variable influences of weather and external temperature. It can be applied to all those purposes for which water-proof material is used, and it is well adapted to form gas-tight membraues for regulators of pressure of compressed gas, bags or sacks for dry gas meters, as also dry gas reservoirs. — *Dr. Hirzel*, of Leipsic.

Hirzel . . . . . "*Scientific American*," xxxix. 338.
"*Iron Age*," xxii., Aug. 1, 19.

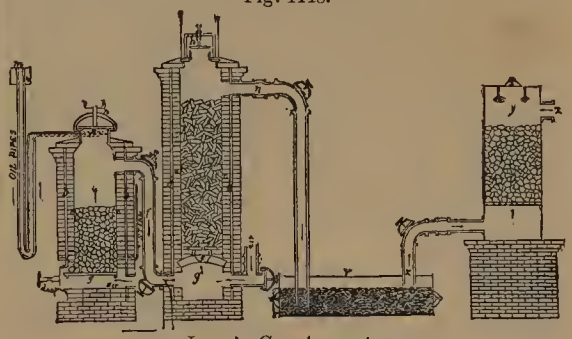
Gas Ap'pa-ra'tus. The Lowe gas-producing apparatus is shown in Fig. 1148.

Beginning on the left, the consecutive apparatus are — the generator, super-heater, washer, and scrubber.

The operation is as follows: —

The generator is kindled through door at base; charged

Fig. 1148.



Lowe's Gas Apparatus.

with anthracite from top and closed; the valve at top of super-heater being opened, and outlet at right of same closed.

Blast is applied below grate bars of generator, which, passing upward through same, and dowuward by connecting pipe, enters base of super-heater and passes upward through the perforated arch and the mass of loose fire-brick out into smoke-stack.

The gases thus carried from the coal into bottom of super-heater are met there and ignited by au air-blast, evolving an intense heat. When the anthracite is at cherry red, the second is white hot.

The blast is then shut off, top of super-heater closed, and its outlet opened. Hot steam is introduced below into the incandescent coal, while crude petroleum, led through trapped pipes, is simultaneously dropped thereon from above. The resulting gases pass off together into and through the super-heated fire-brick, by contact therewith being made permanent, and thence go through washer, scrubber, etc., to holder.

Melville's process, 1805-1813, is among the earliest in the history of the industry, and is shown in "*American Gas-light Journal*," * July 3, 1876, p. 9.

See CARBURETOR, GAS MACHINE, etc. See list under GAS, *supra*.

Gas Bag. (*Gas.*) A device to stop the flow of gas in a pipe or main during repairs or alterations. A hole is tapped, the collapsed bag inserted, and then inflated by means of the service cleaner or other air-pump. They are made with or without valves, either of rubber or of cloth.

Gas Bath. See BATH HEATER, Figs. 243, 244, pp. 82, 83, *supra*.

Gas Bat'te-ry. (*Electricity.*) One which has two platinum or other electrodes, one in oxygen, and the other in hydrogen, in two inverted cups, their edges submerged in acidulated water.

Invention of *Grove*. See elaborate form of the apparatus, Fig 37, p. 2526, "*Scientific American Supplement*."

Ganot's "*Physics*," * 1877, p. 729.

du Moncel, Paris, 1856, p. 122.

Noad, London, 1859, p. 293.

See also BEQUEREL BATTERY for his oxygen gas battery, which was the first constant battery, the first double fluid battery, and the first to use a porous cell.

See dissertation on Gas Batteries, *Niaudet*, American translation, 242.

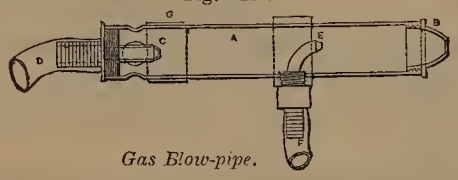
Gas Blow'-pipe. Fig. 1149 shows Wenham's gas blow-pipe, as adapted for the mouth blast or foot bellows.

D is the elastic pipe connecting with an ordinary gas burner, and *F* the elastic tube carrying air from the mouth or bellows. *A* is a brass tube into which the gas nipple *C*

and air-jet *E* intrude. *G* is a split ferrule which slips on the tube *A* and regulates the area of air opening according to the supply of gas.

When there is a full supply of gas, and these orifices are quite open, with a strong mouth blast, the spire of flame issuing from the end at *B* will be 4″ or 5″ in length, perfectly

Fig. 1149.



Gas Blow-pipe.

stationary and quiet, and ending in a fine point. If the heat be too great for the purpose required, and the gas supply has to be turned down, the air-regulating ferrule *G* must also be drawn back, else the flame will be extinguished. When properly adjusted, either for maximum or minimum heats, this instrument in either case gives the required pointed flame, and as the orifice of the air jet at *E* is rather smaller than that generally used in an ordinary mouth blow-pipe, a continuous blast can easily be kept up without intermission.

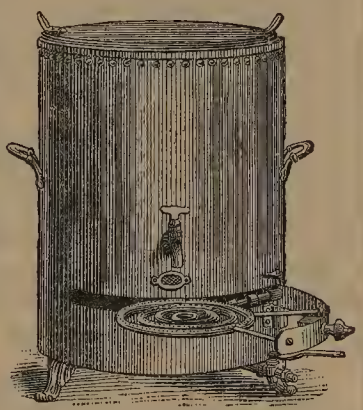
Diameter of nozzle orifice at *B*, .23″; four openings at base, .23″; diameter of orifice gas at nipple at *C*, .07″; orifice of air or blow-pipe jet *E*, .02″.

See also BRAZING BLOW-PIPE, Fig. 421, p. 130, *supra*; and Fig. 2165, p. 946, "*Mech. Dict.*"

Gas Boil'er. 1. A form of steam boiler in which coal gas is used as fuel. In the coal and petroleum regions, especially the latter, there are instances of the escape of natural gas which are largely used in steam boilers and metallurgic furnaces. See p. 944, "*Mech. Dict.*"

Otherwise, the gas boiler is usually a small vertical boiler in which gas is used instead of other fuel, for various reasons: compactness, cleanliness, saving in insurance, convenience of starting fire, easiness of regulation. To keep the boiler at a uniform working temperature, or just to keep up steam, or draw the fire, very small amount of attendance is necessary.

Fig. 1150.

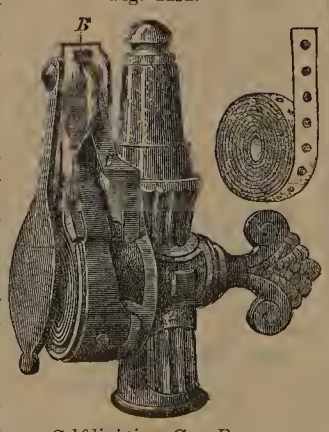


Portable Gas Boiler.

Under CROSS-TUBE BOILER, VERTICAL BOILER, suitable forms of boilers are shown.

2. A small boiler for bath, conservatory, or domestic uses. When used for green-houses it is fixed outside the house, and the upper and lower portions of the boiler are connected by wrought-iron pipes in which the water circulates, as in the ordinary water heater. In the form shown the boiler is portable, and has an enamel lining.

Fig. 1151.



Self-lighting Gas Burner.

Gas Burn'er. Fig. 1151 is Stockwell's self-lighting gas burner. It has a chamber with a coiled strip of paper, on which are dots of fulminating compound. By turning the key, the paper coil is partly unrolled, and a pellet exposed to the action of a spring hammer at *B*, which causes a flash and thus ignites the gas instantly. *A* is a bent piece of metal, the lower portion of which enters a slot in the rear wall of the chamber, and has a projection below at right angles, which enters a circular hole in the disk, so that the rotating of the latter, in one way or the other, by the key, causes said piece to ascend or descend. The square upper end of the piece presses against the tape, and consequently raises and unwinds the same, as the key is turned vertically. At the same time, the piece *A* pushes back the spring hammer *B*, until the bend in the former at *C* is reached, at which point the hammer is released and carried forward by the spring, strikes one of the dots of fulminate, explodes the same, and so lights the gas. The arrangement of parts is such that the hammer does not fall until just as the key is placed so as to turn the gas fully on, which insures ignition. Each roll of tape contains 135 fulminate dots.

Chaussenot's gas-burner, adjudged the prize de la "Société d'Encouragement," 1836, is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," ed. 1877, article "*Eclairage*," tome iv.

Parissot's, ditto.

See also	* "*Scientific American Sup.*," 2772.
For heating, *Ehret* . .	* "*Scientific American Sup.*," 460.
McGeorge	* "*Scientific American*," xliii. 312.
Self regulating, *McMillan* . . .	* "*Scientific American*," xxxv. 4.
Paper by *Pattinson* .	"*Scientific American Sup.*," 291.
Sugg, Br.	* "*Scientific American Sup.*," 3963.
Argand, *Sugg*, Br .	* "*Engineer*," xlvii. 106.
And lantern, *Sugg*, Br.	* "*Engineering*," xxvii. 142.
Self lighting, *Stockwell*.	* "*Telegraphic Journal*," vi. 243.
	* "*Scientific American*," xxxiv. 211.

See also BUNSEN BURNER, p. 146, and BURNER, p. 147, *supra*, and p. 2411, "*Mech. Dict.*"

Gas Bur'ner Reg'u-la'tor. A device to cause a constant delivery to the jet notwithstanding changes in pressure in the main. It is usually a hollow cone lifted by the pressure of gas and protruding into a hole in the septum which divides the chamber from the burner.

* "*Scientific American Supplement*"	2291.

Gas Check. A ring at the rear of the chamber of a cannon which prevents the escape of gas rearwardly in breech-loading guns. Also known as an *obturator*.

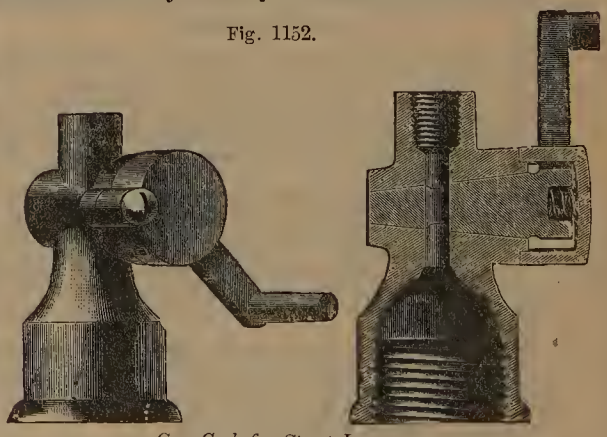
Broadwell's, Fig. 60, Appendix L, "*Ordnance Report*," 1877, copper and steel gas check. App. II, 4 * *Ibid.*, 1879, p. 74.

* "*Engineer*"	xlvi. 439.

Gas Cloth. See GAS AND WATER TIGHT CLOTH, *supra*.

Gas Cock. Fig. 1152 shows Peck's gas cock for burners of street lamps. It is conical in shape, is not held and adjusted by the usual end screw, but

Fig. 1152.



Gas Cock for Street Lamps.

is forced to its seat by a spring beneath the cap, which is itself held by a clamping screw. The object is to give the spigot the required fit, and to prevent its being tampered with in order to make it easy to turn.

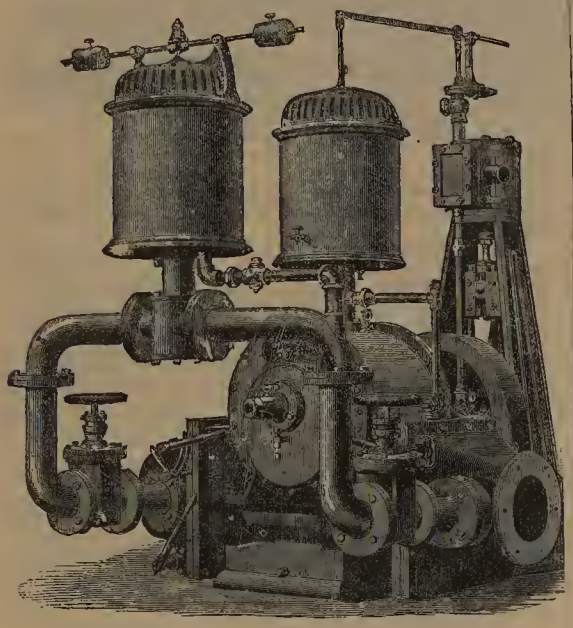
Gas Com-pen-sa'tor. (*Gas.*) An aid to the governor, in order to maintain equal pressure (or

vacuum, as the case may be) in the action of the exhauster. The latter is assumed to be of a capacity in excess of the possible need, and its action under the circumstances of the varying production of gas, in different seasons, portions of the day, during the changing of retorts, etc., requires automatic compensation. For this purpose it has a *governor*, *compensator*, and *bye-pass*.

Fig. 1153 shows a convenient disposition of the whole apparatus arranged in compact form upon a single bed plate. Made on a scale for works of moderate size it occupies but 5′ × 5′ space in the exhauster room and includes engine, exhauster, governor, compensator and bye-pass.

The exhaust fan is driven by the engine on the right, the fly-wheel shown in the cut being upon the fan shaft. Above the case is the governor, in which is a bell raised by the pressure of gas beneath it and by means of the vertical stem and counterbalanced lever operating the throttle valve of the engine. When the pressure under the bell in the governor

Fig. 1153.



Gas Compensator and Allied Apparatus.

becomes greater owing to the increased production of gas, the bell rises and the steam valve is opened by the means cited, accelerating the motion of the exhaust fan. See also Gas Governor.

The *compensator* is an aid to the same main result, but has no action upon the engine. Its duty is as an accessory in cases where the exhauster is running at a rate beyond the supply of gas to support, and its immediate duty is to open a valve in the chamber at mid-length of the bye-pass, and so throw the portions of the main at the respective sides of the exhauster into communication. The effect is to allow the gas to circulate around the exhauster and equalize the pressure on both sides to a certain extent.

Passing into the base of the compensator is seen a pipe carrying gas. The weight of the bell within is compensated by the lever arms above, the weights being slipped towards or from their fulcra according to the adjustment required.

Gas Com-press'ing Pump. Pumps for condensing gas for car-lighting purposes are used by the Pennsylvania Railway, storing the gas in tanks 9′ 11½″ long, 12″ diameter, with cubic capacity of 12,995″. The gas is obtained from the city main and condensed to a pressure of 300 lbs. per square inch. From these it is conducted to reservoirs under the cars.

* "*Engineering*" . . . . . xxiii. 397.
Bouvet . . . . . * "*Scientific American*," xxxviii. 73.
Brush . . . . . * "*Scientific American Sup.*," 300.

See also Gas Liquefaction Apparatus.

Gas Con-den'ser. (*Gas.*) The multitubular condenser is an apparatus for condensing the tar from the gas.

It consists of a cast-iron box, or series of boxes, with two horizontal diaphragms or partitions, one near the top, and the other near the bottom; the upper and lower spaces thus formed are connected by cast-iron pipes, usually about 4″ in diameter, placed as closely together as possible. The middle space of the box is filled with water, surrounding the pipes.

A series of boxes is thus arranged side by side, the gas is admitted into the lower space and passes up through the pipes to the upper space; from there it goes to the top space of the next box, down the pipes to the bottom space, thence into the next box, up the pipes, and so on, thus traveling up one set and down the other until the temperature of the gas is reduced sufficiently low by the water surrounding the pipes to cause the tar, etc., to be deposited in the lower space, from which the tar is run off into cisterns constructed for the purpose. The water surrounding the pipes is admitted from the end of the series of boxes opposite to that at which the gas enters, so that the water surrounding the pipes through which the gas first passes is the warmest (the heat having been acquired by the flow of gas), and that at the end where the gas leaves the condenser is the coolest. In this way the cooling of the gas goes on gradually, and is not too sudden in its change of temperature at any point, and the rapidity of cooling is easily controlled by regulating the amount of fresh water admitted to the condenser.

This form of condenser is largely used in this country, but is almost unknown in Europe, where, as a general thing, the temperature of the air is relied upon to cool the gas, which is passed through pipes exposed to the air out of doors for the purpose. The great advantage of the multitubular method is the control it gives to the rate of cooling.

Herring & Floyd's multitubular condenser, "*American Gas-light Journal*," * July 3, 1876, p. 13.
Mackenzie's surface condenser with bye-pass, *Ibid.*, p. 12.
Cross . . . . . * "*Scientific American*," xxxix. 22.
Pelouse & Andouin, Fr. . * "*Engineering*," xxv. 489.

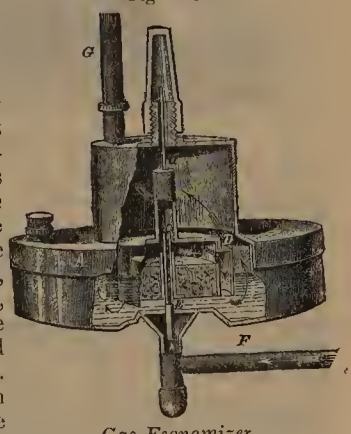
Gas Con-duct'or. (*Metallurgy.*) The downcast shaft at the side of a blast furnace, leading the heated gases from the top of the furnace to the hot-blast oven (*B*, Fig. 2588, p. 1134, "*Mech. Dict.*"), for heating the feed air of the furnace. Four such downtakes are shown in Fig. 5222, p. 2223, *Ibid.*

Gas De-tect'or. (Fr. *chercher-fuites.*) A torch for detection of leaking joints in pipes or gas apparatus.

Gas Drip Pump. A plumber's hand-pump, for removing water of condensation collected in gas piping.

Gas E-con'o-mi-zer. A carburetor for enriching gas by passing it through a hydrocarbon liquid. *F* is the pipe from the meter, and *G* the pipe leading to the burners. A float, *D*, slides upon a tube, *E*, and rests upon the hydrocarbon liquid in the chamber *A*. The gas is driven in the direction of the arrows, through the hydro-carbon, being enriched in its passage, and has always the same quantity of liquid to rise through, as the edge of the float *D* is equally submerged whatever the depth of liquid.

Fig. 1153.



Gas Economizer.

Gas saver, *de Palos* . . . "*Scientific American*," xlii. 164.

Gas En'gine. Gas engines are divisible into two systems: —

1. That system in which the expansive force of the gases acts directly upon the piston and, through this, upon the other moving parts, as in the Lenoir and Hugon engines, and

2. That in which the force of the explosion urges the piston (which for the moment is free) until a partial vacuum is created below it, when the atmospheric pressure is brought to act, and at

the return stroke produces the effective work. This includes the Otto and Langen engine.

The upright Otto-Langen gas used at the Centennial Exhibition of 1876 has been superseded by the *Otto* horizontal gas-engine.

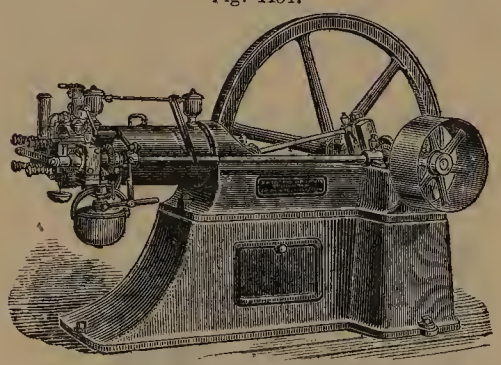
In the *Otto-Langen* engine coal gas and air are mixed in such proportions as to give a mildly explosive compound, and are admitted under a piston which slides air-tight in a vertical cylinder open at top.

The piston-rod urges the shaft only in an intermittent manner; it is geared to a pinion on the shaft which engages the shaft by means of a friction pulley only on the down stroke. On the up stroke the piston is driven violently by the expansive force of the gases till the pressure of the mixed products equals the atmospheric pressure, and is carried beyond this point by acquired momentum. It stops only when the work of the atmospheric resistance has absorbed the accumulated work in the piston. There results a rarefaction under the piston, so the down stroke is urged by atmospheric pressure aided by the weight of the piston. This descent is the effective stroke of the engine, for it is only then that the piston-rod is connected to the driving-shaft.

A variable automatic governor is attached. The piston-rod has teeth on one side working in a pinion, and is steadied by slides on the other side.

"This method of employing the effects of the explosion only indirectly has yielded good results economically; affording one-horse power for a consumption of one cubic meter of gas per hour, in place of 2.7 m., as in the Lenoir and Hugon engines. But the noise of the engine, as in the former cases, is quite unendurable, and has led to its rejection." — "*Armengaud.*"

Fig. 1154.



Otto Gas Engine.

The Otto gas engine consists mainly of a jacketed cylinder, with piston, slide valve, and governor, having a cut-off mechanism to regulate the supply of gas according to the varying load on the engine. The pressure utilized for the production of the power is generated in the cylinder, and at once used therein to propel the piston. This pressure is due to the combustion of a mixture of common coal gas and air, which is ignited by a small flame, carried from a burning gas jet outside into the cylinded by the motion of the slide. A small part only of the charge is combustible, which, on ignition, serves to expand the remainder, thus avoiding the shock, due to explosion of the whole charge.

In the Otto engine (as also in the Simon) the mixture of air and gas is compressed before explosion, so that the initial pressure at the moment of ignition is 12 atmospheres.

"The two ideas of previous compression of the mixed gases and a gradual combustion, instead of a violent explosion, distinguish the improved engines from the old forms. [Hugon and Lenoir.]

The Otto engine resembles externally a single acting steam engine. It has a single horizontal cylinder, open at one end and closed at the other, with a head furnished on the inner side with a conical cavity. The piston is connected by a crank with the shaft of the fly-wheel. Behind the cylinder is the supply chamber, which is furnished with a direct connection with the main shaft. The piston at the in-stroke does not reach the end of the cylinder, but leaves a space equal to about two fifths of the capacity of the cylinder. This is the compression chamber.

"The cylinder serves the double purpose of compression pump and working cylinder, which is perhaps not the least of the characteristics of the new system.

"The complete cycle of motions in the Otto engine is accomplished only by two complete revolutions of the working shaft, or four strokes of the piston. It comprehends the four following phases, namely: —

"1. The piston makes an up-stroke, drawing in the explosive mixture of gas and air;

"2. The inlet cock closes and the piston returns, compressing the gaseous mixture;

"3. At the moment the down-stroke is completed, and while the tension of the gases is somewhat above two atmospheres, the mixture is inflamed, and the consequent expansion causes the piston to make an up-stroke.

"4. The piston returns, driving out the expanded and cooled gases.

"Thus, of four strokes of the piston, only one (the third) conveys motive force to the shaft.

"The second consumes power; the other two have no appreciable effect.

"Such a method of working calls for a heavy fly wheel, the accumulated work of which accomplishes the compression of the gases.

"A special regulator to the engine intercepts the supply of gas and delays the ignition whenever the velocity becomes too great. Furthermore, the engine works without noise — a great advantage over the Otto and Langen motor.

"The effective working power of the engine is of course the difference between that afforded by the expansion of the gases and that absorbed by the compression. The indicator diagrams show a regular curve of pressures very different from the line of abrupt changes exhibited by the Lenoir engine.

"The regular decrease of pressure in the Otto engine is due to the method of burning the mixed gases. The combustion is retarded, so that the heat developed is absorbed by the gases at a rate that is in better accord with the motion of the piston.

"M. Otto has accomplished this by his method of mixing and admitting his gases. He employs two different mixtures; one of fifteen parts air to one of illuminating gas, which he calls his 'feebly explosive mixture;' the other of seven parts air to one of gas, is called his 'strongly explosive mixture.'

"During the working of the engine, and at the moment when the gases are about to be ignited, the contents of the cylinder are: products of the preceding explosion, atmospheric air, hydrogen and hydro-carbon gases. These are not uniformly diffused, but owing to the position and action of the valves, the most combustible portion is at the bottom of the cylinder at the point of ignition, and the combustibility probably decreases quite regularly from the bottom of the cylinder to the piston.

"The result of this condition is a *prolonged* explosion, and the force of expansion is less of the nature of a shock than in the previous engines.

"In order to insure combustion with proper rapidity, a jet of 'strongly explosive mixture' is made to traverse the mass at the critical moment." — *Armengaud.*

The Gilles gas engine combines the two plans of action in the same engine.

The pressure produced by the ignition of an explosive gaseous mixture in the cylinder of the engine is applied to propel two pistons in opposite directions, that is to say, a working-piston and a loose piston, the former of which is connected by crank with a driving-shaft, and the latter of which is free, but is temporarily held by a clamp after its propulsion by the explosion of the gaseous compound, to secure the return action of the working piston under atmospheric pressure as against a reduced pressure between the two pistons, thereby obtaining a motive power for the working piston in both directions of its stroke.

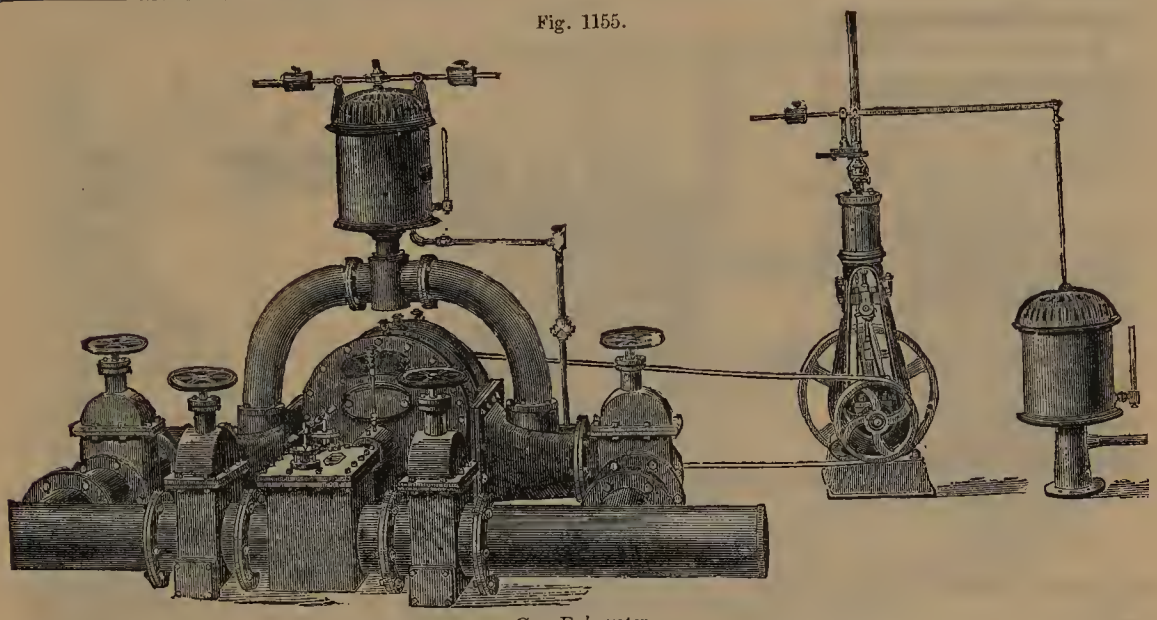
The principle of action of the Simon engine is essentially the same as the Otto, but there are some notable differences in the details. The compression is performed in a separate cylinder: upon the admission to the working cylinder the mixture is ignited by a gas flame kept constantly burning. The cylinders are vertical, and the two piston-rods connect with the same horizontal shaft.

The admission of the explosive mixture and the escape of the products of combustion are managed by valves worked by cams on the working shaft. The mixed gases are admitted in a series of small charges and inflamed successively, thereby insuring a gradual expansion.

Simon uses steam in connection with the gaseous mixture; a jet of steam from a boiler heated by the escaping gases, the water supplied to the boiler being first used to cool the working cylinder. The steam lubricates the piston.

The Bisschof engine belongs to the class that utilize the effects of an explosion to drive the piston. The cylinder is vertical, and the piston-rod connects with the shaft in such manner as to utilize in the fullest degree the effect of ex-

Fig. 1155.



Gas Exhauster.

pansion. No water is employed for cooling the cylinder; the result is secured by construeting the cylinder with projecting ribs or flanges, so as to expose an abundance of radiating surface.

Engines of small size only have thus far been constructed on Bisschof's system. Most of those made have been designed to run sewing machines, with a capacity of 1-15 to ½ a horse-power. The working of these eosts, in Paris, two cents an hour for the former, and only five cents for the latter size.

The report on gas engines at the Vienna Exposition of 1873, vol. iii., § A, pp. 162 *et seq.*, includes notices of

Lenoir, Fr,
Leavitt, U. S.
Hugon, Fr.
* Brayton, U. S.
* Otto-Langen, Ger.

The report by M. Armengaud, Jr., at the Conference at the Trocadéro, 1878, was printed in the "*Revue Industrielle*," and reproduced in "*Van Nostrand's Magazine*," xx. 148. It includes notices of the following: —

Papin, 1688. *Barber*, 1791. *Mead*, 1794. *Street*, 1794. *Lebon*, 1799. *Hugon*, 1858. *Lenoir*, 1859. *Otto-Langen*. *Otto*. *Simon*. *Bisschoff*. *Ravel*.

See also Gas Engine, * pp. 947-949, "*Mech. Dict.*"

At Paris Exposition . . . * "*Van Nostr. Mag.*," xx. 148.
* "*Manuf. & Builder*," x. 188.
* "*Scientific Am. Sup.*," 1507.
Hurd, Br. . . . . * "*Engineering*," June 25, 1880.
* "*Sc. American*," xxxviii. 356.
Bisscsoff . . . . . "*Iron Age*," xxii., Feb. 6, 11.
* "*Sc. American*," xxxix. 390.
Gilles . . . . . * "*Scientific Am. Sup.*," 691.
Brayton . . . . . * "*Scientific Am. Sup.*," 339.
Otto . . . . . * "*Scientific Am. Sup.*," 339, * 1853, * 2322.
* "*Scientific Amer.*," xxxviii. 195; * xxxix. 386.
* "*Iron Age*," xxii., Oct. 31, 1.
* "*Polytechnic Review*," May, 1876, p. 49.
Paper on, *Armengaud, Fils.* "*Technologiste*," xli. 84-90.
"*Revue Industrielle*," 1878.
"*Van Nostr. Mag.*," xx. 148.
Bisschof, Fr . . . . . * "*Engineering*," xxvi. 331.
Clerk, Br. . . . . * "*Engineer*," xlviii. 26.
Clayton, Br. . . . . * "*Engineer*," xlviii. 25.
Gilles, Ger . . . . . * "*Scientific Amer. Sup.*," 691.
Vertical, *Humboldt & Gilles*, Engl. . . . * "*Sc. American*," xxxvii. 178.
Humboldt & Gilles, Br. . * "*Engineer*," xliv. 39.
Langen-Otto . . . . . * "*Polytechnic Review*," May, 1876.
Otto, Ger. . . . . * "*Engineering*," xxvii. 565.
* "*Engineering*," xxvi. 155.
"*Van Nostr. Mag.*," xviii. 66.
Otto & Langen . . . . *Deschanel's* "*Natural Philosophy*," i. 491.
* "*Eng. & Min. Jour.*," xxvi. 205.
Gas, steam, and air engine. *Simon*, Br. . . . * "*Engineer*," xlvii. 43.

Gas Ex-haust'er. A rotary fan in the gas main of the works, drawing the gas from the retorts and sending it to the holder.

Another form of exhauster is McKenzie's, which acts by means of a steam jet in the manner of an ejector in a portion of the pipe of diminished area. See Steam-jet Exhauster.

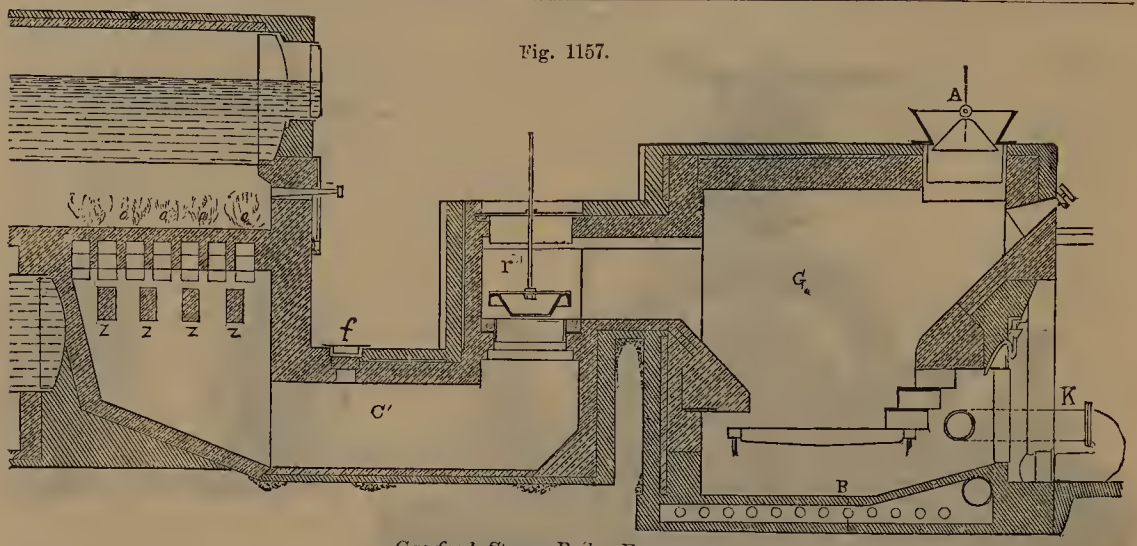
The apparatus in Fig. 1155 shows an arrangement of *exhauster* in the main-pipe circuit, a *bye-pass* arched above the exhauster, and itself surmounted by the *compensator*. To the right is a vertical *steam-engine* for driving the exhauster, and itself regulated by the *governor* on the extreme right, which is actuated by gas admitted by a pipe from the main.

Pressure of gas in the inverted bell within the governor raises the bell, and by means of the stem and the counterbalanced lever raises the valve of the engine and puts on more steam. The increased pressure in the governor is thus made to accelerate the motion of the fan in the exhauster, and remove from the retorts the gas generated. The exhauster itself may be said to be upon a sort of bye-pass, as it is a U loop lying laterally from the direct line of main shown in the foreground. In this direct line are two stop valves, and between them is a chamber with a pair of butterfly valves which act automatically in a certain contingency; that is to say, if the gas exhauster should cease to operate by the stoppage of the engine or the running off its belt, for instance, the pressure of the gas coming from the retorts would open the butterfly valves and prevent the stoppage of the circulation, which might otherwise burst the retorts. The stop valve on each side of the safety-valve chamber is to cut the latter out of the circulation when it may be necessary to examine or remove it.

The principal bye-pass, on which the exhauster is situated, has also its stop-valves by which it can be cut off, when necessary. The bye-pass shown in arched form above the exhauster is in order to keep a certain equal pressure in cases where the exhauster may be working at a speed beyond the power of the retorts and subsequent apparatus to supply. It is common to provide an exhauster of somewhat more than the necessary capacity, and the bye-pass, the valve of which is actuated by the compensator, establishes a switch connection between the mains on the respective sides of the exhauster, when the difference between the pressures in the two exceeds a certain limit. The compensator is shown above the bye-pass, and is described under Gas Compensator: where is also shown another arrangement of exhauster, compensator, steam engine, exhaust-governor, bye-pass, pipes and valves.

Roots' . . . "*Am. Gas-light Jour.*," * July 3, 1876, p. 17.
Prosser & Ray's . . . . . * *Ibid.*, p. 14.
Smith & Sayres' exhauster and bye-pass . * *Ibid.*, p. 11.
McKenzie's steam jet exhauster . . . . * *Ibid.*, p. 11.
Körting . . . . . * "*Eng. and Min. Jour.*," xxi. 464.
* "*Scientific American Sup.*," 800.
Beale, Br. . . . . * "*Engineer*," xli. 227

Fig. 1157.



Gas-fired Steam Boiler Furnace.

Gas-exhauster governor.

Allen . . . . . * "*Scientific American*," xli. 15.

French

Art. Eclairage au Gaz. * *Laboulaye's* "*Dict.*," *etc.*, ii., Figs. 45, 46.

Gas Ex-haus'ter Gov'er-nor. (*Gas.*) An apparatus to regulate the engine driving the exhauster, so that the speed of the engine is in proportion to the pressure of the gas coming from the retorts, in order to keep the pressure in the latter (or the vacuum, as the case may be) equable. See GAS EXHAUSTER.

Goodwin "*American Gas-light Journal*," * July 3, 1876, p. 4.

Gas Fire-pot. An iron chamber heated by gas and artificial air blast, used for heating soldering irons.

Gas-fit'ter's Pump. One for discharging pipes of air, or blowing away obstructions in gas pipes.

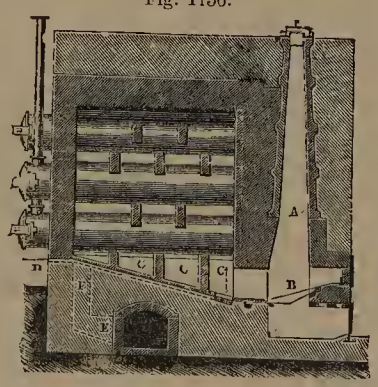
Gas-fit'ter's Torch. A form of lamp usual in the trade. It has a thick wick, and is used to detect escape of gas by applying it to suspected places.

Gas Fur'nace. 1. A furnace for distilling gas from coal, or other form of carbon.

The application of the Siemens and Ponsard furnaces to the distillation of coal in gas-works is shown under GAS-GENERATING FURNACE, Figs. 1159–1162, pp. 385–387, *infra*.

The subject of gas production is considered on pp. 944, 955, 956, "*Mech. Dict.*" An additional illustration may be

Fig. 1156.



Muller & Eichelbrenner's Gas Furnace.

given in the furnace of MM. Muller and Eichelbrenner, which has a magazine charger, *A*; grate bars, *B*, on which the carbonic oxide produced by the burning of coke is carried into flues *C C*, and mixed with air entering at *D*, while the waste products of combustion after the circuit of the retort chamber are conducted by the flue *E E* to the chimney.

2. A furnace in which coal gas from the main furnishes the combustible. See GAS HEATER; GAS STOVE; BATH HEATER; BUNSEN BURNER, etc.

Hoffmann's gas combustion furnace.

Griffin's gas furnace, for heating tubes, and for combustions in organic analysis.

Griffin's blast gas-furnaces are shown in Griffin's "*Chemical Handicraft.*"

3. A furnace in which gas from the combustibles is substituted for the combustibles themselves in the furnace proper. See GAS-GENERATING FURNACE; GAS PRODUCER, etc.

4. A steam-boiler furnace heated by gas; either coal gas from the main, or gas produced in the grate, as in the gas generating furnace.

The gas-fired steam-boiler furnace of Haupt, of Brieg, Germany, is shown in Fig. 1157.

The principle of firing is the same as in Fig. 1159, *infra*, the coal being fed at the hopper *A* into the furnace *G*, where it rests upon the grate in such thickness that the carbonic acid produced by the lower layer of fuel resting immediately upon the grate is compelled to pass through the layer of fuel above it, and there combines with an additional amount of carbon. *K* is a Koerting air injector which supplies air, previously heated to 190 C. in pipes which are built into the walls of the producer and boiler, and a portion of which are shown below the ash-pit *B*.

The volume of combustible gases passes by the fire-brick arches *z z*, and uniting with a volume of air coming in from the side is diverted into a mixing chamber, from which the combined volume issues, and is ignited at the points *a a*.

Some trouble was experienced in lighting the gas at starting in such a manner as to prevent explosion, but there seems to be no radical reason why the plan so successful in the producers of Siemens, Ponsard, Casson, and Bicheroux, should fail in the special application to steam boilers.

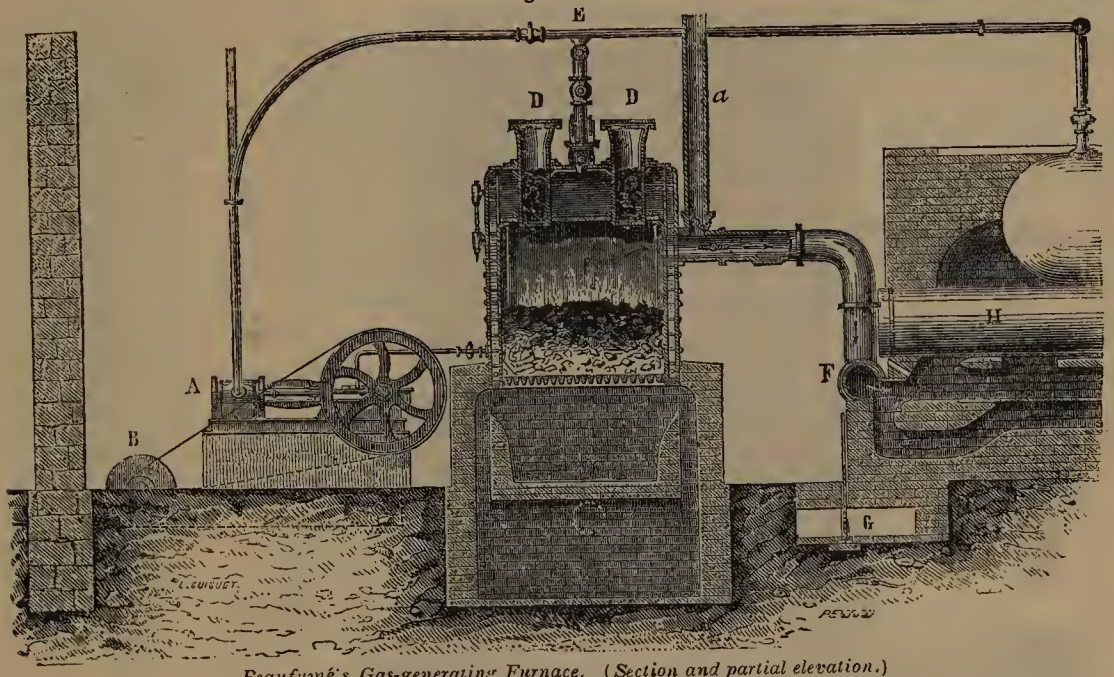
The furnace of Casson uses screened slack, supplied in a hopper and drawn down into the grate. Through the back of the grate it is blown by hot air drawn from the incased sides of the nearest stack. Hot air is likewise taken in at the top, and also at the bottom of the furnace, and makes its way to the exit of the gas from the gas furnace before it passes over the bridge of the puddling furnace, and the hot air fires the gas. The fierceness of the flame can be regulated by the quantity of air admitted, and the air is under the control of the furnace man.

See references under GAS-GENERATING FURNACE.

Gas-gen'er-a-ting Fur'nace. One in which gas from combustibles is substituted for the combustibles themselves in the operative chamber.

It is sometimes called the *Regenerator gas furnace* because in the Siemens, Bicheroux, and other systems, it is connected with the use of a *regenerator*. The Siemens (see Fig. 1159) has two pairs of chambers, each pair alternately being heated by the outgoing gases from the furnace, and forming a heating

Fig. 1158.



Beaufumé's Gas-generating Furnace. (*Section and partial elevation.*)

chamber for incoming gases for combustion and air respectively.

The Ponsard (see Figs. 1161, 1162) has a single regenerator chamber in which the draft of waste gases in one set of conduits, and of inflammable gases in the other conduits, are constant, and only divided by brick walls through which the heat of the waste is conducted to the air and carbonic oxide.

In a sense, all grate-firing may be considered as *gas generating*, inasmuch as the solid parts of the fuel are converted into gas and then burned. Thus coal parts in the grate with about 30 per cent. of its weight in the form of hydro-carbon gases, and the remaining coke is also converted into carbouic oxide, aud burnt into carbonic acid.

The distinction, however, which constitutes a grate-firing furnace a *gas-generating furnace*, is that the coal is in such thickness that the carbonic acid produced by the combustion of the fuel in the lower layer next to the grate is compelled to pass through the incandescent fuel above it, and thus again combine with carbon, preventing also, it may be added, the passage of unconsumed oxygen. This necessitates the admission and admixture of atmospheric air at another point besides that through the grate.

One of the first attempts in this line was the English patent of Juckes, No. 7858, Nov. 8, 1838. This had a magazine, and the coal was thrust into the fire by a piston which traversed in a hollow chamber in which the hydro-carbon gas was expelled from the coal before it reached the bed of coal on the grate. All the air was, however, admitted through the grate, so that this did not come under the present deuomination, but was evidently intended as a smoke-burner or smoke preventer.

Price's English patent, 3,462, of 1873, has a magazine but no mechanical feeder, and the air is supplied only through the grate. The coal, however, in the expulsion chamber is heated by waste heat.

An early form of gas-generating furnaces was that suggested by Ebelman, but much improved by Beaufumé, under whose name it is well known iu France.

The apparatus is shown in Fig. 1158. It has a furnace, *C*, with a grate enveloped in a double casing of boiler iron, like a locomotive furnace. Water circulates in the interval between the casings, and above is a steam dome. Steam passes by a pipe from the steam dome to a steam pump, which supplies water to the jacket. Fuel is introduced by means of two chargers, *D D*, which have valves above and below to prevent the exit of the hot gases from the furnace *C*. The upper valves being lifted, coal is placed in the chargers *D D*, and these valves being then closed the lower valves are opened and the fuel dropped on to the fire. The same device for feeding fuel to the furnace may be seen in Bennett's steam engine, U. S. patent, August 3, 1838 (Fig. 52, p. 21, and Fig. 81, p. 39, "*Mech. Dict.*"), which has several other points of similarity to the Beaufumé furnace.

The small engine *A* also drives a blower *B*, which forces air under pressure beneath the grates, and the ash-pit is uecessarily hermetically sealed. This combustion under pressure and the sealed ash-pit are found in the Bennett patent, above cited, and also in the following patents: —

Washburn, U. S., Sept. 5, 1865.

Stillman, U. S., Aug. 9, 1864, and several others mentioned under AËRO-STEAM ENGINE and AIR ENGINE, "*Mech. Dict.*"

A portion of the air is inducted, as has been said, beneath the grating of the furnace *C*, but another part is destined for the consumption of the combustible gases beneath the steam-boiler shown at the right hand in the figure. The quantity of air devoted to the respective objects is regulated by registers.

The body of combustible in the furnace *C* is designed to be about sixty-five centimeters in height, in order that the requisite chemical combination may take place, the carbonic acid produced in the red coke-fire beneath, being converted iuto carbonic oxide in traversing the superior stage of fuel, combining with another equivalent of carbon to form an inflammable gas when mixed with air beneath the steam-boiler.

Steam, in regulated quantity, is injected beneath the grate, and ascending with the air is decomposed iu the mass of burning fuel. The use of the steam is said to reside in serving to regulate the heat of the gas producer, and also in assisting in keeping the grate surface clear. The generation of the gases by decomposition of the steam is admitted to bo at the expense of heat, but its introduction has a practical value in working, and is adopted by Siemens and others.

The hot gas passes by a lateral pipe to the space beneath the steam-boilers, being mixed with air from the chamber *G* in the pipe *F*, from thence circulating in the furnace passages beneath the boiler. *a* is a chimney used in starting fires in the furnace *C*, or upon other occasions as may be necessary; valves at the point of juncture of the respeetive pipes determine the course of the air

The Siemens' gas-generating furnace is the most noted of the class, and is used for many purposes. Invented in 1856, it was applied in 1864 to the production of steel by the Siemens-Martin process, and received the grand prize at the Exposition in Paris, 1867. Since that it has beeu used in glass-making, gas-works, etc.

It consists of three parts: the gas producer; the regenerator; the furnace chamber. The latter may be an open metallurgic hearth, a siege full of glass pots, or a nest of gas retorts, as the case may be.

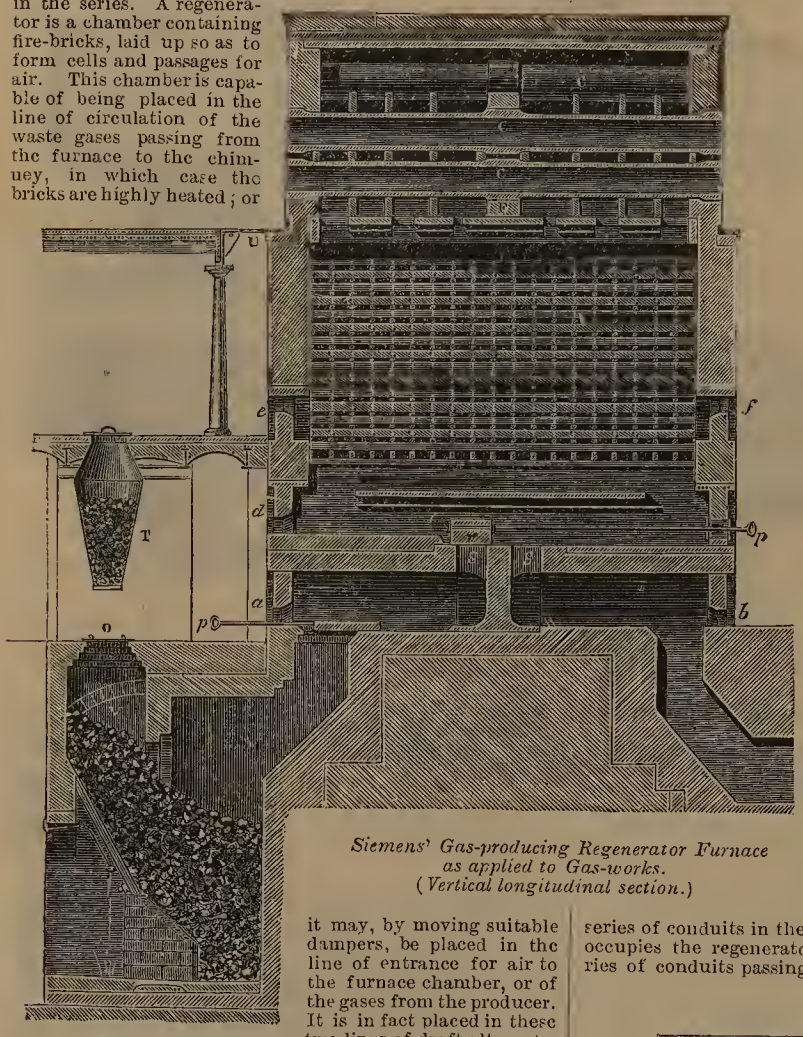
It is distinguished from the preceding by the notable absence of a forced current of air, and of the heating of the incoming air in tubes.

The furnace of the gas producer is fed through a hole above, which is closed by a cover at other times. The fuel descends an inclined plane of bricks made of refractory clay, and thence slides on to a grate surface, also inclined. The resulting gases pass upward into an exit pipe, the chemical conditions being much as in the Beaufumé furnace just described. The result of the combustion of coke, carbonic acid, passing upward through the mass of heated fuel, receives another equivalent of carbon and passes to the exit pipe as carbonic oxide, diminished in its heat by the cost of its transformation into oxide of carbon, which heat is, however, restored when the ignition takes place subsequently.

The current of heated gas passes by flues to the *regenerator*,

the second essential portion in the series. A regenerator is a chamber containing fire-bricks, laid up so as to form cells and passages for air. This chamber is capable of being placed in the line of circulation of the waste gases passing from the furnace to the chimney, in which case the bricks are highly heated; or

Fig. 1159.



Siemens' Gas-producing Regenerator Furnace as applied to Gas-works.
(Vertical longitudinal section.)

it may, by moving suitable dampers, be placed in the line of entrance for air to the furnace chamber, or of the gases from the producer. It is in fact placed in these two lines of draft alternately: the first to be heated; the second to heat the aëriform matters passing through it. To secure continuity, two of such chambers are required, alternately heated and imparting heat, and in the Siemens' practice each of them are in pairs, as it is found advisable not alone to superheat the gases from the *producer* but also the air to inflame them, and to do these separately, and combine them after they are heated in the *regenerator*. Meanwhile the other pair of chambers is being heated by the gases flowing from the furnace chamber towards the chimney.

The action in the furnace chamber is according to the circumstances: whether the flame descend upon the ore or metal in the bosh, or circulate around glass-pots, or envelop crucibles filled with coal.

Figs. 1159, 1160, show the Siemens' regenerator-furnace as applied to the purpose of distilling coal for lighting gas. While his invention was first applied in steel furnaces, it has for some time been in use in gas-works, first of all in the "*Usine de Vaugirard*," belonging to the Parisian Gas Company.

The *gazogene* or *generator*, V, otherwise known as the *gas producer*, is placed below the ground level, and the gas produced, drawn by chimney draft, passes first to the *regenerators* and thence to the combustion chamber in which are the retorts *C C*. The regenerator, as has been said, is an assemblage of refractory bricks built up in such a manner as to leave between them interstices which are traversed by the waste gases from the combustion chamber on their way to the chimney.

The regenerator in the case in question has four compartments shown at a a^1 a^2 a^3 in Fig. 1160, which is a vertical transverse section, in a line at right angles to that shown in Fig. 1159.

At the bottom of these conduits are the dampers R R^1 R^2 R^3, by which the direction of the current is controlled.

Supposing the furnace to be in operation: the conduits a a^1 receive respectively, one the carbonic acid from the gas-producer, and the other the air for its combustion, the two united forming the flame beneath and around the retorts *C C*, in the combustion chamber. The proceeds of combustion descend by a^2 a^3. At the end of an hour, the direction of all these currents is reversed; the air and carbonic oxide traverse the conduits a^2 a^3, the bricks in which have been heated to redness, and the waste heat passes downward in a a^1, to heat that chamber in turn.

One gas producer heats 8 to 10 furnaces.

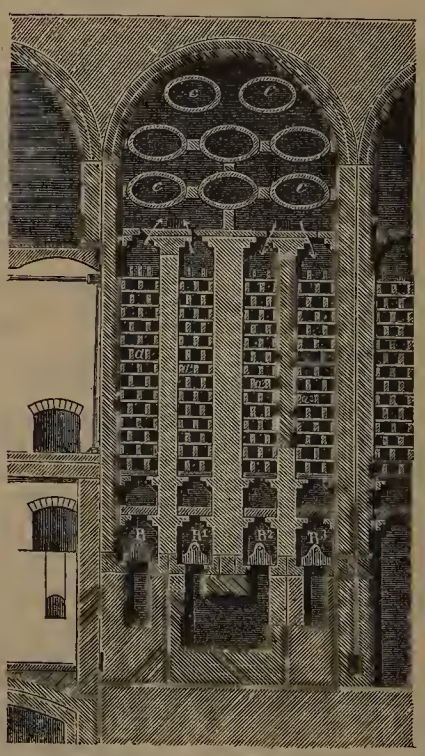
In the apparatus shown in Figs. 1159, 1160, the furnaces are fed with coke, that being the convenient fuel in gas-works, and the retorts are heated by burning the carbonic oxide.

The coke is fed into the furnace from a charger *T*, the furnace cover *O* being removed when the shutter at the foot of the charger *T* is moved aside to drop the charge into the furnace *V*. Water is shown trickling from a pipe on to the ash floor beneath the grates. *a b d e f*, Fig. 1159, are orifices, which may be opened or adjusted to verify or regulate the draft in the interior of the furnace. The dampers R R^1 R^2 R^3, are coupled two and two, and are operated by the draw-rod *p* to open one set of openings *s* and close the other, when the direction of draft through the generators is to be changed, as has been already explained.

The Ponsard furnace, which is shown in Figs. 1161, 1162, as applied to the same object, distilling gas in gas-works, has the same general features as the Siemens, with two exceptions to be noted. This proceeds upon a somewhat simpler plan.

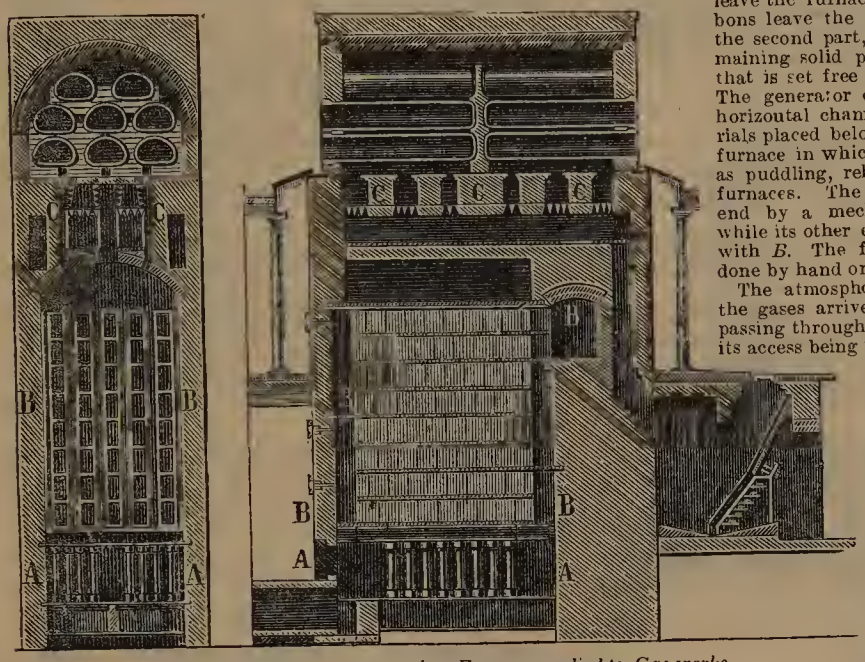
1. The reversal of the direction of draft is avoided in the Ponsard regenerator furnace. The waste products of combustion follow constantly the same direction, descending from the combustion chamber and coursing through the series of conduits in the structure of hollow fire-bricks which occupies the regenerator, while the air follows another series of conduits passing upward in contact with the bricks,

Fig. 1160.



Siemens' Gas-producing Regenerator Furnace as applied to Gas-works (vertical transverse section).

Fig. 1161. Fig. 1162.



Ponsard's Gas-generating Furnace applied to Gas-works.
(Vertical transverse and longitudinal sections.)

the other surfaces of which are heated by the descending waste current.

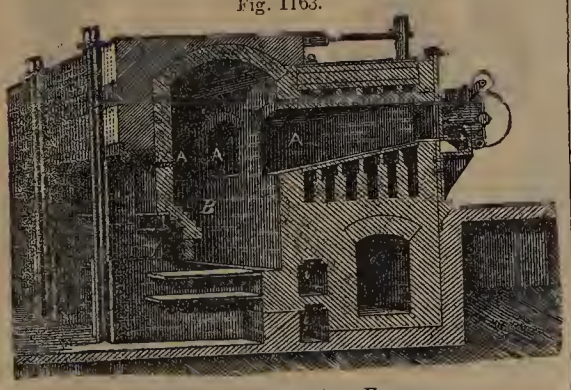
2. The carbonic oxide from the gas-producer proceeds directly to the combustion chamber, where it unites with the air which has entered at *A*, and passed from top to bottom around the heated air-ducts in the regenerator *B B*. The air occupies the space around these fire-brick ducts, while the waste heat passes horizontally through them. *C C* represent portions of the vault of the regenerator, through openings in which the heated air rises to the combustion chamber. The particular form and disposition of the air-ducts is attributed to M. Lencauchez. Ponsard's regenerator is also shown under REGENERATOR, which see.

The gas-generating furnace of Minary, of Besançon ("*Publication Industrielle*," 1868), has admission of air subsequent to the departure of the heated gases from the producer, see Fig. 3, p. 4000, "*Scientific American Sup.*," where is also shown Brook & Williams' Gas Generator, Fig. 4.

Gröbe's Gas Generator has been used at the Osnabruck Iron and Steel Works, since 1849; at the Vieille Montagne Zinc Works, and at several other places in England, Belgium, and Hanover. This furnace is founded upon the principle that the processes of expelling the hydro-carbon gases, and converting the resulting coke, require entirely different conditions. To expel the gases from the fuel, not atmospheric air is required, but only heat; while for the combustion of the coke into carbonic oxide, atmospheric air is essential. The latter process requires no heat, but on the contrary throws heat off, which is ordinarily employed for expelling the gases from the fuel, and having thus become latent, it cannot be used in the combustion chamber.

The gases contained in the coal are expelled in one chamber, *A*, and the solid remains (coke) are converted in another, *B*, and both gases so produced are burned in the combustion chamber, which is not visible on the figure.

Fig. 1163.



Gröbe's Gas-generating Furnace.

A is heated by the waste gases after they leave the furnace, and the expelled hydrocarbons leave the chamber *A* highly heated. In the second part, *B*, the conversion of the remaining solid parts takes place, all the heat that is set free being utilized in the furnace. The generator consists of one, two, or more horizontal chambers, made of fire-proof materials placed below, above, or by the side of the furnace in which the gases are utilized; such as puddling, reheating, zinc, glass, and other furnaces. The chamber, *A*, is closed at one end by a mechanical feeding arrangement, while its other end is open and communicates with *B*. The feeding of coal into *A* can be done by hand or by machinery.

The atmospheric air necessary for burning the gases arrives highly heated by previously passing through channels heated by waste heat, its access being regulated by valves. The waste heat, after passing through the flues, round *A*, to expel the gases from the fuel, and heating the resulting coke to a bright red heat, may then be used under boilers, etc. See also: —

Gas producer. Regenerator.
Open hearth furnace. Slack-burning gas furnace.
Glass furnace.

See also the following references: —

"*Eng'ing & Mining Journal.*"
Bicheroux . * xxi. 55; xxiv. 262.
Siemens . xxvii. 93; xxix. 151, 372.
Strong (water gas) . * xxx. 315.

Ponsard . . . . . * "*Engineering*," xxv. 450.
Tessié . . . . . * "*Eng'ing*," xxviii. 458; xxix. 318.
Jukes, 1838 . . . . . * "*Engineering*," xxx. 200.
Price, 1873 . . . . . * "*Engineering*," xxx. 200.
Minary, 1868 . . . . . * "*Engineering*," xxx. 200.
Brooke & Wilson, 1877, * "*Engineering*," xxx. 200.
Gröbe, 1879 . . . . * "*Engineering*," xxx. 200.
Müller & Fichet . . . "*Engineering*," xxix. 2.
Hartmann (2 Figs.) . . * "*Engineering*," xxix. 2.
Heaupt (14 Figs.) . . * "*Engineering*," xxix. 2.

"*Scientific American Supplement.*"

Bicheroux . . . . . * 88, 1331.
Minary . . . . . * 4000.
Casson . . . . . * 596.
Boëtius . . . . . * 1346.
Ponsard . . . . . * 2355.
Brook & Wilson . . . . . * 4000.
Rickmann (glass) . . . . . * 4000.
Gröbe . . . . . * 2176.
Tessié . . . . . * 3820.

"*American Manufacturer and Iron World.*"

Siemens . . . . . * xxvi., May 7, p. 1.
Wilson . . . . . * July 16, 1880, p. 12.
Tessié . . . . . * xxv., Aug. 8, p. 12.

Ponsard . "*Van Nostrand's Engineering Mag.*," xxi. 252.

"*Iron Age.*"

Bicheroux . . . * xxvii., Jan. 13, p. 24; Jan. 20, p. 1.
Casson-Bicheroux . xxv., May 6, p. 1.
Siemens . . . . * xx., July 12, p. 5; Dec. 20, p. 3.
xxv., April 22, p. 13.
Parkes, Br. . . . xxvii. March 16, p. 5.
Ponsard . . . . * xxii., Dec. 12, p. 1; xxv., Mar. 25, p. 7.
Siegel . . . . * xxvi., Oct. 7, p. 1.
Tessié . . . . * xxiv., Aug. 14, p. 1.
Gröbe . . . . * xxvi., Oct. 7, p. 3; * xxii., Dec. 19, p. 3.
Haupt . . . . * xxv., March 11, p. 1.
Wilson . . . * xxiv., Oct. 23, p. 1.

"*Engineer.*"

Smith . . . . . * xlii. 62.
Boëtius . . . . . * xliv. 5.
Rickmann (glass) . . . . . * xlv. 457.
Ziebaith & Pulsch . . . . . * xlv. 110.
Ponsard . . . . . * xlv. 231.
Bicheroux . . . . . * xlvi. 91.
Jukes . . . . . * l. 191.
Price . . . . . * l. 191.
Minary . . . . . * l. 192.
Brook & Wilson . . . . . * l. 192.
Gröbe . . . . . * l. 192
Fichet, Fr. . . . . * xliv. 454.
Frew, Br. . . . . * xlv. 234.

Siemens (glass) . . "*Manuf. and Builder*," xii. 270.
in U. S. . "*Manuf. and Builder*," xii. 50.
Illuminating . . . * "*Manuf. and Builder*," viii. 166-169.
Croll, illuminating * "*Manuf. and Builder*," viii. 198.
Siemens . . . . "*English Mechanic*," xxvii. 657.

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Casson-Dormoy . . . . . * xl. 22.

United States Patents:

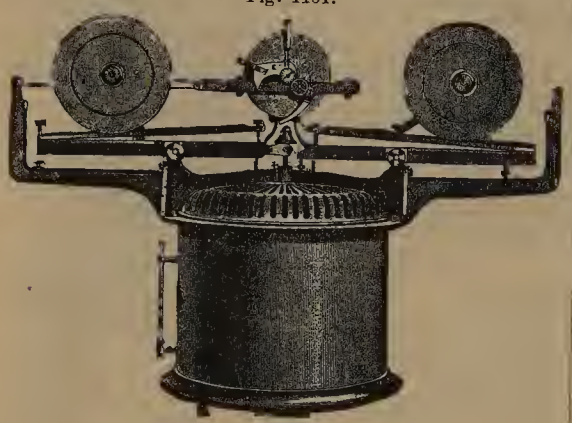
212,942. *Jerzmanowski.* March 4, 1879.
213,313. *Brook & Wilson.* March 18, 1879.
216,119. *Tessié & Jerzmanowski.* June 3, 1879.

Gas Gov'er-nor. (*Gas.*) *a.* An apparatus of the nature of a regulator, to equalize the flow of gas in a pipe.

The usual method is to cause the pressure of gas to impinge upon a diaphragm to which is connected the stem of a valve, and the valve opening is diminished in proportion to the increase of pressure, and conversely.

Fig. 1164 shows Isbell's automatic gas-governor, for regulating the pressure of gas in street mains, proportioning the pressure to the necessity of the varying consumption at different periods of the 24 hours; as, for instance, a day pressure of $\frac{7}{10}''$, a night pressure of $2\frac{4}{10}''$, continued until 10.30 P. M., and then gradually diminished to a midnight pressure of $1\frac{1}{10}''$, and then gradually back to day pressure.

Fig. 1164.



Isbell's Automatic Gas Governor.

The rolling weights are governed by the clock in the center, and as they roll towards or from the clock they depress the levers on which they track, and actuate accurately balanced valves in the chamber below; the valve-rods will be seen depending from the end of each lever.

The rolling weights are connected by a chain to a sliding bar, working between friction rollers, and driven by a cam, on the main spindle of the powerful clock contained in the case. As the weights are moved in, at the proper time, by the action of the clock and cam, the valve below is opened and the pressure gradually increased to the desired point, held there, until the time set for it to be diminished, by the rolling back of the weights and the consequent gradual closing of the valve. The cam is easily and quickly secured in any position on the spindle, and has stamped upon it the hours of the day, as shown by the index.

It will be at once apparent how any desired effect can be obtained, by changing the position of the cams, or by putting on cams of different proportions.

The *Kidder-Noyes* gas governor acts by means of a balanced holder which fluctuates upward or downward upon any increase or decrease respectively of gas pressure above or below the mean for which it is set, to close or open the valve in the main.

Cox's (Br.) gas governor has the same general feature of balanced holder operating a valve.

Goodwin has a similar arrangement; and also a governor on the aneroid principle of an expanding diaphragm chamber.

Foster's governor, for tanks of compressed gas for railway cars and steamboats, has also the expansible diaphragm arrangement.

White (Br.) has a swinging flap-valve weighted with shot.
Foulis (Br.) has a double-cone valve and float.
Jones (Br.), a conical valve in perforated diaphragm.
Wharton has gravitating valves in a section forming a part of the line of pipe.

b. An apparatus on a gas exhauster to regulate by gas pressure the quantity of steam admitted to the cylinder of the engine driving the exhauster, so as to regulate the speed of the engine, and thus maintain any desired pressure or vacuum on the exhaust side. See GAS EXHAUSTER.

Goodwin's consumer's governor, "*American Gas-light Journal*," * July 3, 1876, p. 6.
Goodwin's governor, *Ibid.*, p. 7.
Stott, Br. . . . . * "*Engineering*," xxix. 308.
For compressed-gas tanks * "*R. R. Gaz.*," vii., opp. p. 138.

Gas Grate. A contrivance of Dr. Siemens, in which the consumption of coke in the grate is aided by a row of gas jets; illustrating his theory of the economy of separating fuel into its constituents of coke and gas, and re-associating them at the grate or hearth.

Gas Gun. A signaling device, consisting of an explosion of gases in a pipe. Used at Howth Baily light station, Kingstown Harbor, Ireland. See Major Elliot's report, U. S. Engineers.

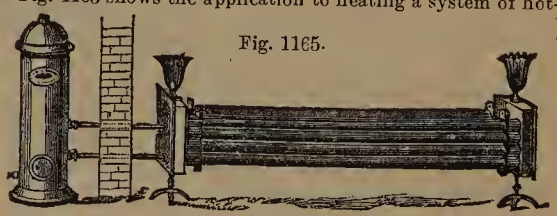
The gun is a tube of iron connected with the gas holder by a ½" pipe. The charge is a mixture of oxygen (3), coal gas (3), and air (2).

See also FOG GUN, Fig. 1079, p. 352, *supra*.

Gas Heat'er. 1. An application of gas as a means of heating water for domestic purposes: culinary, lavatory, conservatory, etc. See GAS BOILER, *supra*.

Fig. 1165 shows the application to heating a system of hot-

Fig. 1165.



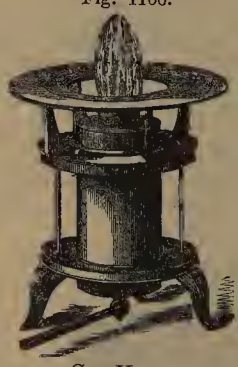
Conservatory Heater.

water pipes for a green-house. See also BATH HEATER, Figs. 243, 244, pp. 82, 83, *supra*.

2. A form of burner for heating kettles or baths, and for laboratory purposes.

See also BUNSEN BURNER, Figs. 471-475, pp. 146, 147, *supra*, and references *passim*.

Fig. 1166.



Gas Heater.

3. A substitute for a forge in tempering drills, punches, and other small tools.

Fig. 1167.

Gas Heater.

Put on a sufficient head of gas to prevent the flame from descending into the tube. For heating larger pieces, the flame should be nearly 3" wide. The upper ends of the curved side pieces should not be more than ¼" apart. The articles to be heated should be held in the upper part of the flame, above the central blue part and parallel with it. The larger the piece to be heated the further it should extend into the flame. The heater should be located in a dark place, and supports may be provided for greater convenience in heating heavy articles.

* "*Scientific American*," xxxv. 275.
And boiler, Br. . * "*Engineer*," xlviii. 404.
For motor, *Hill*. * "*Scientific American Supplement*," 616

Gas Hold'er. The receptacle for gas in gas works. See *g*, Fig. 2161, p. 944, "*Mech. Dict.*"

Gas holder, large . . . . . * "*Man. & Builder*," x. 4.
Berlin . . . . . * "*Engineering*" xxiii. 49.
5,680,000 cubic feet, London . * "*Engineer*," l. 175.
Receiver, Liquid . . . . . * "*Sc. American Sup.*," 2739.

Gash Vein. (*Mining.*) A metallurgic vein, wide above and narrow below.

Gas In'di-ca'tor. A device specially intended to indicate the presence of fire-damp in collieries.

Coquillon's and *Professor Deville's* are instances. See FIRE-DAMP ALARM; GRISOUMETER; CARBUROMETER.

Gas'ket. 1. (*Nautical.*) A plaited cord, used as a stopper in furling sails, etc.

2. A collar or ring used in packing; as around a piston; under a gland; beneath the rim of a fruit-jar lid, etc.

Packing gasket, *Stoy* . * "*Sc. American*," xxxvii. 406.

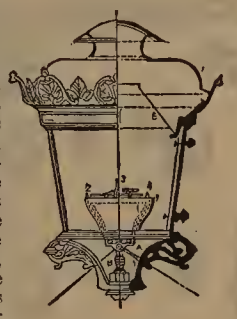
Gas Kiln. A kiln for firing ceramic wares by the combustion of gases.

Mendheim's, Gilmore's report, "*Centennial Exhibition Report*," vol. iii., Group II.,* p. 231.

Gas Lan'tern. The Parisian "*phare*" burner is shown in Fig. 1168.

The lantern is represented partly in elevation and partly in section, the black lines showing the section. 1, 1 are glass cylinders for conducting the air supply to the burners: 2 represents the circle of six flat-flame burners; 3 is a single jet which is lighted after midnight, or when the circle of burners is not needed; 4 is a flash light, which is kept lighted and by which the gas in the burners is ignited when turned on; 5 represents the reflectors. *A* is the lever by which the gas is turned on, and when in this position the gas passes to the circle of burners. When turned in the direction shown by the dotted lines, *B*, the gas passes only to the single jet in the center. It consumes about 40′ of gas per hour when doing its full duty.

Fig. 1168.



"*Phare*" *Burner.*

Gas Light'ing. See the following references: —

Electric, *Bogart* . . . . . * "*Sc. American Sup.*," 698.
French chambers, *Gaiffe* . . * "*Sc. American Sup.*," 456.
Automatic electric, *Fox*, Br. . * "*Engineer*," xlv. 29.
* "*Sc. Am.*," xxxviii. 137.
Burner, *Stockwell* . . . . . * "*Engineer*," xliii. 170.
Lantern and buruer, "Phare," * "*Engineer*," xlix. 210.

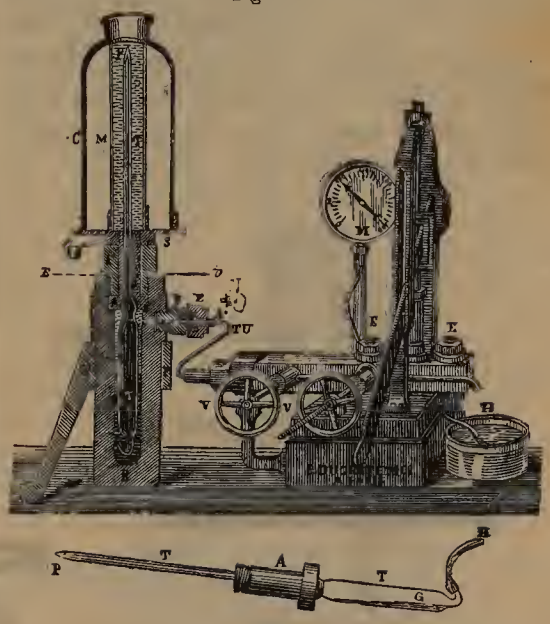
Gas Liq'ue-fac'tion Ap'para'tus. For the liquefaction of gas by pressure and cold.

Cailletet's apparatus is shown in Fig. 1169. A tube, *T*, of very fine bore toward its upper extremity, *P*, and capable of supporting a pressure of 500 atmospheres, is partly filled with the gas to be liquefied. The lower portion of the tube expands to form a capacious bulb, *T*, which is filled with mercury, and inserted in a reservoir containing mercury and water. The walls of the reservoir, *B*, are of steel, and sufficiently thick to allow pressures of 800 atmospheres to be used with perfect safety. The water is forced in by a strong pump, and, according as it enters, the mercury rises in the capillary tube, compressing the confined gas at the same time. A pressure of 200 atmospheres is attained by a few strokes of the pump, and is recorded by a metallic manometer, *E*, *M*. By means of a plunger, *V*, the pressure may be very gradually increased up to 500 atmospheres. Meanwhile the capillary tube may be surrounded by a freezing mixture, or by water at any desired temperature.

In the case of most gases, the manometer remains stationary when a certain pressure has been reached. This phenomenon, which is at variance with Boyle's law (a law absolutely true only for a perfect gas), occurs as soon as liquefaction begins. When an appreciable quantity of the gas has been liquefied, upon gradually diminishing the pressure the liquid begins to boil, and returns to the gaseous condition. But if the valve *V* be suddenly opened, the gas will as suddenly expand, and, undergoing a very considerable reduction of temperature, a portion of it will be liquefied, filling the upper part of the tube with a sort of cloud or mist. These effects are readily seen with nitrous oxide and acetylene

The proceedings of Pouillet, Faraday, Thilorier, and Cagniard-Latour, and the results of their experiments are related by *Laboulaye*, "*Dict. des Arts et Manufactures*," tome iv., cap. "*Liquéfaction des Gaz*," ed. 1877.

Fig. 1169.



Cailletet's Apparatus for the Liquefaction of Gases.

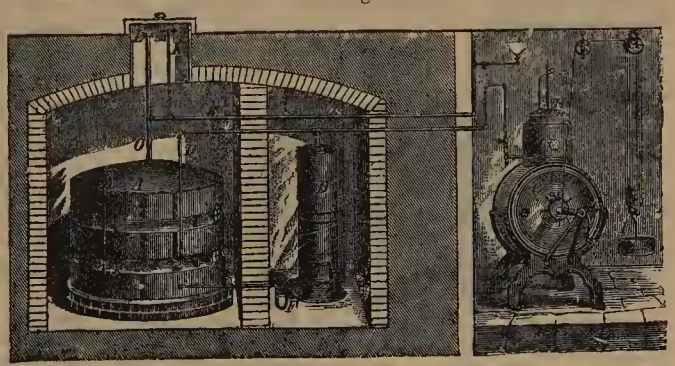
See the following references: —

Cailletet . . . . . * "*Engineering*," xxv. 325, 410.
* "*Sc. American*," xxxviii. 111.
Paper on . . . . . "*Sc. American*," xlii. 249.
* "*Manuf. & Builder*," x. 61.
"*Telegr. Jour.*," vi. 38, 152.
Pictet, Cailletet . . . . * "*Sc. Am. Sup.*," 2030, 2031.
High pressure apparatus for determining volume.
Cailletet . . . . . * "*Scientific Am. Sup.*," 2728.
And solidification, "*Iron*" "*Van Nostr. Mag.*," xviii. 251.
Le Blanc, Fr. . . . . * "*Scientific Amer. Sup.*," 901.
Magnus . . . . . * "*Manuf. & Builder*," x. 132.
Pictet . . . . . "*Sc. Am.*," xxxviii. 64, 71.
* "*Sc. Am.*," xxxviii. 147, 186.
* "*Scientific Am. Sup.*," 1783.
"*Technologiste*," xl. 2.
Densifying . . . . . * "*Eng. & Min. J.*," xxv. 112.
"*Scientific Am. Sup.*," 2485.
"*Sc. American*," xxxiv. 386.
Solidification of gas . . "*Iron Age*," xxi., Mar. 14, p. 7.

Gas Ma-chine'. *a.* An apparatus for carbureting air or gas. See CARBURETOR, "*Mech. Dict.*"

Fig. 1170 shows the "Victor" Gas Machine, which has some points of safety over those previously described. The air pump *C* is in the cellar; the air passes by pipe *D* to a

Fig. 1170.



Gas Machine.

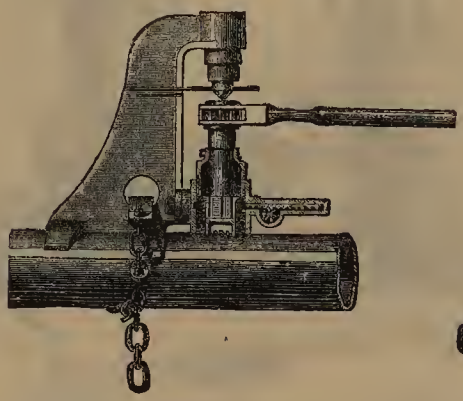
vault at a distance from the house, and there circulates through the carburetor *A*, returning by another pipe *E* to the house service. *K* is an air escape valve; *D*, gasoline supply pipe; *I*, weight to run the air-blower.

b. A gas motor. See GAS ENGINE.

Carburetor . . . . . * "*Am. Man.*," Feb. 14, 1879, 12
Retort, *Kannel & Towsley* . * "*Scientific Amer. Sup.*," 2.
Carburetor, *Maxim* . . . * "*Scientific American*," xliii. 1.
Motor, *Otto*, Ger. . . . . * "*Min. & Sc. Press*," xxxvii. 211.
Motor, *Langen & Otto* . . * "*Scientific Amer. Sup.*," 420.
Laboulaye's "*Dict.*," iv., "*Air chaud.*"
Carburetor, Springfield . . * "*Manuf. & Builder*," viii. 88
Coal, Domestic, *Thomas* . * "*Scientific Amer.*," xxxv. 86.
Carburetor, "Victor" . . * "*Iron Age*," xxi., Jan. 31, p. 7.

Gas Main Drill. A tool for boring holes in mains to attach service pipes.

Fig. 1171.



Gas Main Drill.

Gas Main Valve. Preferably a double-seat valve of large size for mains.

Isbell's double gate gas main valve. "*American Gas-light Journal*," * July 3, 1876, p. 10.
Chapman's gas valve, *Ibid.*, p. 16.

Gas Me'ter.

Goodwin's Experimental Gas Meter, with minute-clock and gas-index combined. "*American Gas light Journal*," * July 3, 1876, p. 7.
Goodwin's wet-test meter, *Ibid.*, p. 7.
Goodwin's experimental meter, *Ibid.*
American Meter Co., various forms of gas-meters, * *Ibid.*, p. 8.
Gas meter indicator, *Price* . * "*Sc. Am.*," xlii. 403.

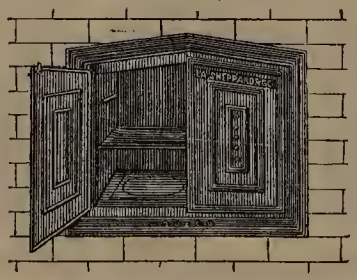
Hopper's double-action meter is a two-diaphragm meter, on the principle of the Glover meter, with its rigid disk and flexible leathern hinge. The two diaphragms are geared together on each side of the partition. Gas admitted in the usual way to the inside and the outside of the diaphragms alternately gives them a reciprocating motion, filling and discharging.

Gas Me'ter Cock. One end screw, the other end solder.

Gas'o-line. A product of the distillation of petroleum; the lightest capable of remaining unvolatilized at common temperatures.

Gas Ov'en. One heated by gas jets. See also GAS STOVE.

Fig. 1172.



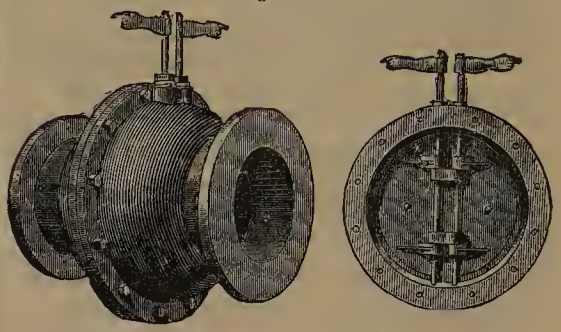
Gas Oven, or Summer Range.

Gas Pipe. The following is the London rule for gas-pipe sizes: —

For 200 lights, 2″ iron tube; 120 lights, 1½″; 70 lights, 1¼″; 50 lights, 1″; 25 lights ¾″; 12 lights, ½″; 6 lights, ⅜″; and 2 lights, ¼″

Gas Pipe Valve. In Root's bye-pass valve, the case consists of two semi-spherical pieces, in which the seats for the doors or valves are cast in

Fig. 1173.

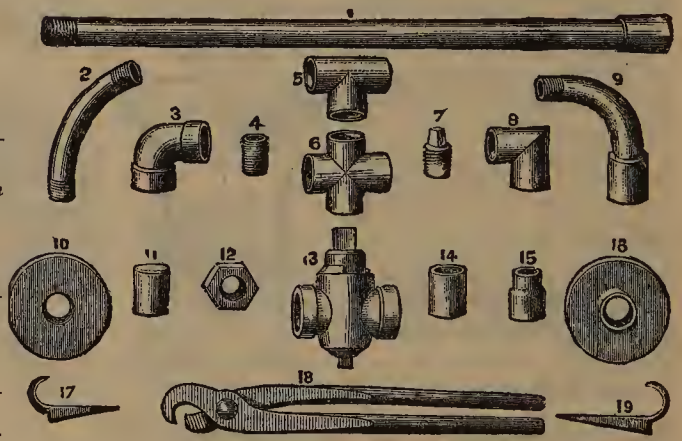


Bye-pass Valves for Mains.

solid, and being circular, the seats and joints can be adjusted and finished on a lathe at one operation.

Gas Pipe Wrench, Con-nec'tions, etc.

Fig. 1174.



Gas Pipe Connections, etc.

1. Tube.
2. ⅛ bend.
3. ¼ bend.
4. Socket.
5. Tee.
6. Cross.
7. Plug.
8. Square elbow.
9. Bend with bell.
10. Flange.
11. Stopper.
12. Nut.
13. Cock.
14. Sleeve.
15. Reducing socket.
16. Flange.
17. 19. Holdfasts.
18. Pipe wrench.

Gas Pres'sure Gage. (*Gas.*) An instrument for measuring and indicating the pressure of gas in the apparatus or mains. There are several forms, one being a bent tube, V-shaped, in which pressure in one leg causes the liquid in the bend to ascend in the other leg, which is graduated; or, conversely, vacuum causing it to descend. See PRESSURE AND VACUUM GAGE.

King's gas pressure and vacuum gage. "*American Gas-light Journal*," * July 3, 1876, p. 3.
King's pressure gages and register, * *Ibid.*, p. 4.
Goodwin's pressure gages and register, * *Ibid.*, pp. 6, 7.
* "*Scientific American Supplement*," 1201.

Gas Pro'cess.

Adams . . . . . "*Min. & Sc. Press*," xxxvii. 23.
Adams . . . . . * "*Scientific Amer.*," xxxix. 15.
Mains, meters, *Chandler* . "*Iron Age*," xvii., Jan. 13, 24.
Apparatus (coal), *Eichholz.* * "*Scientific Amer.*," xxxiv. 63.
Making, *Eicholz* . . . . * "*Iron Age*," xvii., May 4, p. 1.
Generator (simple) . . . . * "*Scientific Amer.*," xxxix. 42.
Hydrogen appara., *Giffard* . * "*Manuf. & Builder*," ix. 262.
Apparatus, illumi., *Kidd* . "*Sc. American*," xxxv. 31.
Lowe . . . . . * "*Sc. American Sup.*," 1551.
Lowe-Strong, series of papers . . . . . * "*Eng. & Min. Jour.*," xxv.
Lowe . . . . . * "*Eng. & Min. Jour.*," xxv. 74.

Lowe . . . . . * "*Min. & Sc. Press*," xxxvii. 137.
* "*Sc. American*," xxxv. 266.
Petroleum, *Lowe* . . . * "*Sc. American Sup.*," 29.
"*Sc. American Sup.*," 836.
"*Am. Gas-light Jour.*," * July 3, 1876, p. 19.
Baltimore. . . . . "*Sc. American Sup.*," 1811.
"*Sc. American Sup.*," 654.
O'ney . . . . . * "*Sc. American Sup.*," 197.
Notes on, by *Patterson* . * "*Sc. American Sup.*," 1176.
Petroleum gas, *Patton*. . * "*Am. Gas-light Jour.*," July 3, 1876, p. 19.
* "*Manuf. & Builder.*," ix. 220.
Pintsch . . . . . "*Iron Age*," xxiii., May 1, p. 15.
Shale oil-works . . . . "*Scientific Amer.*," xxxiv. 112.
Wood . . . . . "*Min. & Sc. Press*," xxxvii. 98, 215.

Symes, coal gas, "*Scientific American Sup.*," 1617.
Wrenn process for making a permanent gas from petroleum, * "*Scientific American Sup.*," 1553.
See "*Éclairage au Gaz*," by Mallet, "*Dictionnaire des Arts et Manufactures*," Paris, 4th ed.

Gas Pro-du'cer. A description of furnace in which gas is produced from coal, to be conducted to a furnace where it is mixed with air and burned. The *gas producer* is the first of the three essential parts of a Siemens' furnace, and is illustrated under GAS-GENERATING FURNACE, which see. See also,

Bicheroux . . . . * "*Iron Age*," xxvii., Jan. 20, p. 1.
Parkes, Eng. . . . * "*Iron Age*," xvii., March 16, p. 5.
Tessié, Lorraine . . * "*Engineering*," xxix. 318.
* "*Iron Age*," xxiv., Aug. 14, p. 1.
Tessié . . . . * "*Engineering*," xxviii. 457,
* "*Scientific American Sup.*," 3820.
Wilson . . . . . "*Amer. Manuf.*," July 16, 1880, p. 12.
* "*Iron Age*," xxiv., Oct. 23, p. 1.
Ziebarth & Pulsch . * "*Engineer*," xlv. 110.

Gas Prov'er. (*Gas.*) *a.* A means for testing the quality of gas. This is a chemical operation, (1.) turmeric or red litmus paper, or (2) acetate of lead paper being used to detect ammonia and sulphureted hydrogen respectively. See GAS TESTING APPARATUS; SULPHUR TESTING APPARATUS; GAS VERIFIER.

b. A test for pressure of fire-damp in mines. See GRISOUMETER; CARBUROMETER; FIRE-DAMP DETECTOR.

c. A means for measuring accuracy of meters. See METER PROVER; CONSUMERS' TEST METER.

d. A means for testing the illuminating quality of gas. See JET PHOTOMETER; PHOTOMETER; TEST METER.

e. A means for testing the levity of gas. See SPECIFIC GRAVITY APPARATUS.

Goodwin, "*American Gas-light Journal*," * July 3, 1876, p. 4.

Gas Pu'ri-fi'er. In Mackenzie & Isbell's apparatus and process for reviving and deodorizing the material in the purifying boxes of gas-works, the air is drawn through the openings in the covers, and through the material in the boxes, by the action of a steam-jet exhauster. No steam engine or rotary device of any kind is needed. The air passing through the purifying material takes up the ammonia and sulphur compounds; mingles with the steam; passes through a condenser or washer, where the steam is condensed and the foul matter removed; the air escaping practically pure.

"*American Gas-light Journal*," * July 3, 1876, p. 12.
Braun . . . . . * "*Scientific American Sup.*," 2757.
Pelouze & Audouin, Fr. * "*Engineer*," xlix. 350.
Still . . . . . * "*Scientific American Sup.*," 914.

Gas Reg'u-la'tor. Another name for the GAS GOVERNOR, which see. An apparatus to cause an equal quantity of gas to pass a gate; contracting the area of the passage as the pressure — and consequent rate of passage — increases; and conversely.

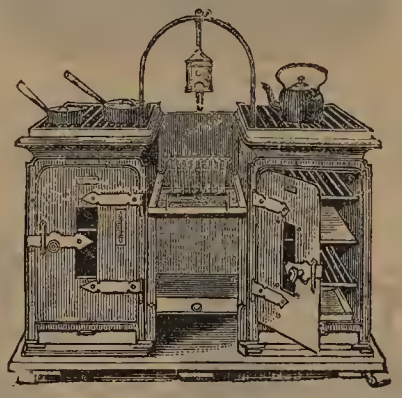
Adams . . . . . * "*Scientific American*," xxxix. 306.
Borrodaile . . . . . * "*Engineer*," l. 218.
"Imperial" . . . . * "*Scientific American Sup.*," 1713.
For steam boilers, *Martin* * "*Sc. American*," xxxvi. 262.
Schooley . . . . . * "*Engineer*," xlviii. 153.
Stott, Br. . . . . * "*Engineer*," xlix. 210.
* "*Man. and Builder*," x. 181.

Gas'si-ot's Cas-cade'. (*Electricity.*) A beaker, internally coated with tin foil to within a short distance from the top, is placed on a glass disk resting on the plate of an air-pump. The whole is covered with the glass receiver, from the top of which depends a glass-covered conductor reaching nearly to the bottom of the beaker, the end of the conductor being exposed. Upon passing a high-tension current from the said conductor to the plate of the machine, and exhausting the receiver, a continuous electrical discharge takes place, passing up out of the cup, and in a cascade form, to the supporting plate.

"*Philosophical Magazine*" . . . . . vii. 854.

Gas Range. A form of cooking-stove heated by gas jets, and having the conditions of the range

Fig. 1175.



Gas Range.

as distinct from the stove. It is fitted with 2 ovens, with thermometers attached; also with 5 burners on top for boiling, preserving, stewing, and broiling. See also GAS STOVE, and references *passim*.

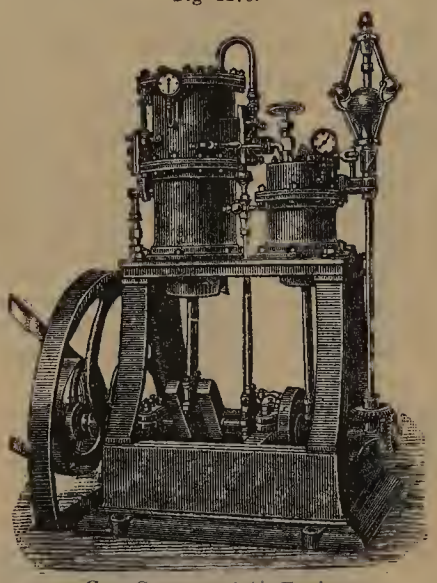
Gas, Steam, and Air En'gine. An aërogas engine with steam added. The gas is not used explosively but for the rapid expansion of atmospheric air previously compressed in a cylinder forming part of the engine. A small steam generator is heated by the combustion of the gas and the hot exhaust gases from the power cylinder, the steam being used in the latter to increase the power of the engine.

Simon's engine has two cylinders, one in which air is compressed in mixture with a determinate quantity of gas, and the other into which the mixture passes and is ignited by a constantly maintained flame, the air reëxpanding from the pressure due to its compression, and under the influence of the heat of combustion of the gas and partial combustion of the air.

Fig. 1176 is a perspective view, and Fig. 1177 a sectional elevation of the engine.

In Fig. 1176, *A* is the pumping or compression cylinder; *B* the piston working therein; *C* the connecting-rod, connecting it direct with the crank shaft *G*, on which is the fly-wheel *H*, and bevel wheels *Y*, which by means of the shaft *X* work the governors *O*, connected with which is a sliding cam, *D*, sliding on a feather in the shaft *X*, and connected with the governors, so as to be drawn upwards when, owing to the increased speed of the engine, the balls fly apart. The effect of this is to allow the runner at the end of the slide valve *E* to fall on the narrower part of the cam *D*, and thus to open the air passage *F*, and the gas passage *K*, for a shorter time, admitting less gas and air until the pressure falls, and the speed of the engine is reduced, when the runner of the slide valve *E* again rides on the wider part of the cam *D*. A spring, not shown in the drawing, gives the return motion to the slide valve *E*, and maintains the runner in contact with the cam *D*. After passing through *F* and *K* respectively, the air and gas pass into the chamber *L*,

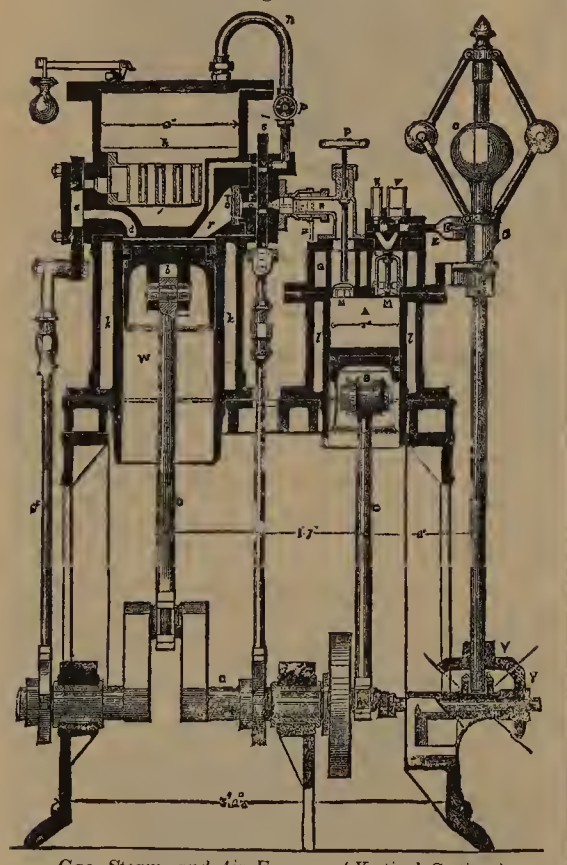
Fig. 1176.



Gas, Steam, and Air Engine.

whence they are drawn through the valve *M* into the cylinder *A* by the down-stroke of the piston *B*. By the return stroke of the piston *B* the gas and air are compressed and discharged partly through the pipe *R* into the combustion

Fig. 1177.



Gas, Steam, and Air Engine. (Vertical Section.)

cylinder, and partly into a receiver, *Q*, from which the internal constant flame at *T* is supplied; *N* is a back-pressure valve; *P* is a stop valve. When this is screwed down the compressed mixture cannot pass into the pipe *R*, and the motion of the engine is arrested; *R* being a tube through which the compressed contents of the air-pump *A* pass to the slide valve *S*, worked by the rod *g*, and which admits the mixture through perforated brass disks and wire gauze at *T* into the interior of the working or combustion cylinder *W*. A small pipe, *Z*, also proceeds from the receiver, *Q*, to the interior of the cylinder *W*, opening at the point indicated by the black spot under *T*; *b* is the piston in the cylinder *W*, and *c* the rod connecting it with the crank shaft *G*; *d* is the outlet for the exhausted gases to the slide valve *e*, actuated by the connecting-rod *f*, which admits them to an arrangement of tubes in the water chamber *h*, from which they are afterwards led away through the exhaust port indicated into the center of the tube space. The water in *h* is in communication with the water in the jacket or casing, *k*, surrounding the cylinder *W*. This water is also in communication with a similar casing or jacket, *l*, surrounding the cylinder *A*. The heat of the combustion in the cylinder and the heat of the exhausted gases generate steam in the chamber *h*, which passes by the pipe *n*, opened or closed by the stop valve *p*, and a port, *V*, in the slide-valve *S*, into the passage *r*, and thus into the cylinder *W*. The water employed is first admitted into the jacket of the compression cylinder, where it keeps that cylinder sufficiently cool, and is at the same time slightly heated. From this jacket it passes to that of the working cylinder, and gains in temperature while it cools the cylinder, and thence passes to the steam generator *h*. To start the engine it is first turned a few revolutions so as to compress air and gas in the cylinder *A*, some of which passes into the space *Q*. A small cock in the pipe *Z* is then opened, and a plug opposite the spot under *T* is withdrawn and the gas ignited. The plug is then replaced, and the pipe *Z* sustains a constant flame in the interior of the cylinder *W* at *T*, through which flame the mixture of gas and air compressed in *A* passes, and in thus passing is ignited. The consequent expansion causes the piston *b* to make a down-stroke, imparting motion to the crank shaft *G*, and at the same time the piston *B* of the cylinder *A* compresses and discharges into the pipe *R* and the receiver *Q* a fresh supply of gas and air. The momentum acquired by the fly-wheel brings the piston *b* of the cylinder *W* back to its highest position, and the above described action is repeated.

Gas Stove. Fig. 1178 is a parlor or office stove. It is of cylindrical form, and is fitted with a highly polished copper reflector, and is designed to use illuminating jets only. The heat is thrown into the room by reflection from the copper reflector, also by radiation from the hot-air chamber, the heated air passing into the room through outlets in top of stove.

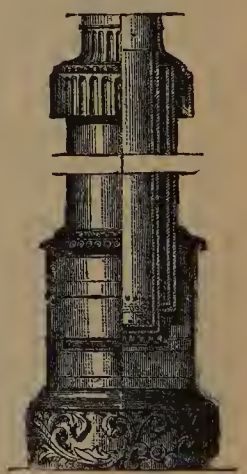
This stove is designed for use in bath and hall rooms where a connection cannot be made with flue.

A stove 27″ high, 8″ diameter, requires 8″ cubic of gas per hour.

Fig. 1178.

Parlor Heater.

Fig. 1179.



English Gas Stove.

Fig. 1179 is a view of an English office gas-stove, partly in elevation and partly in section.

It has an annular pipe pierced with numerous holes for the exit of gas, and situate in an ornamental cylindrical casing to which the air has access. This circle of lights is surmounted by a system of cylinders in cast-iron which absorb the heat developed by the combustion of the gas, and part with it to the surrounding air.

Fig. 1180 shows an adaptation for cooking-stoves. The joint is in the roasting oven, and the heat is reflected from the congeries of gas jets above it.

The baking oven is heated from below and by the heat passing through the flues around it, to the boiler plate above.

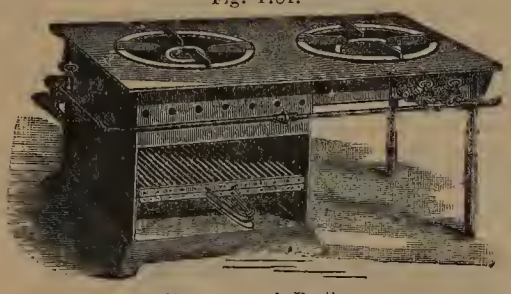
Fig. 1180.

Gas Cooking Stove.

Fig. 1181 is a combined furnace and sub-flame broiler; requiring no special description.

Gas heaters of various kinds are described and shown under specific heads, such as BUNSEN BURNER; BURNER; GAS BLOW-PIPE; GAS HEATER; GAS BOILER; BATH HEATER, etc.

Fig. 1181.



Furnace and Broiler.

Gas Tar Pump. A device to enable the tar pump to be constant in its stroke and action, but limiting the amount of tar raised to the quantity running into the well; keeping a constant level in the well, though the product of tar be irregular.

"*Scientific American Supplement*" . . . . . * 1412.

Gas Test'ing Ap'pa-ra'tus. *a.* The test for ammonia in illuminating gas is to allow a jet of the gas to blow upon a piece of turmeric or reddened litmus paper; for the detection of sulphureted hydrogen use similarly acetate of lead paper.

Hugh Young's apparatus is founded upon this method, pieces of turmeric and acetate of lead papers being suspended in a small glass receiver over an inlet of gas passing to a burner. This testing apparatus is only qualitative.

Dr. Letheby's quantitative sulphur testing apparatus has a meter, governor, and tube leading to a Leslie burner, under which is a beaker containing the requisite quantity of standard liquor ammonia, over the beaker is a glass funnel passing up through the burner, and covering the burner is a trumpet-shaped glass tube which discharges into a large glass condensing cylinder with bent glass tube at an angle of 45° at its farther end.

The *Gas referees' apparatus*, London, has points of similarity to the Letheby apparatus, but uses carbonate instead of liquid ammonia, and its condenser is vertical and contains marbles and has a sealed discharge pipe for liquid of condensation. See SULPHUR TESTING APPARATUS.

The apparatus for taking the specific gravity of illuminating gas is a modification of the Bunsen method (*Bowditch*, 1857, p 237) by efflux through a fine opening in a thin plate of metal. See SPECIFIC GRAVITY APPARATUS.

In the use of Goodwin's apparatus for the analysis of coal gas, the proceeding is first by qualitative analysis to determine the presence of certain gases; this will decide the order of precedence in their removal. See GAS ANALYZER.

The apparatus consists of graduated glass tubes through solutions in which the gas is bubbled. The re-agents, formulæ for making them, and the directions for procedure in analysis, are in a pamphlet. W. W. Goodwin, Philadelphia, 1877.

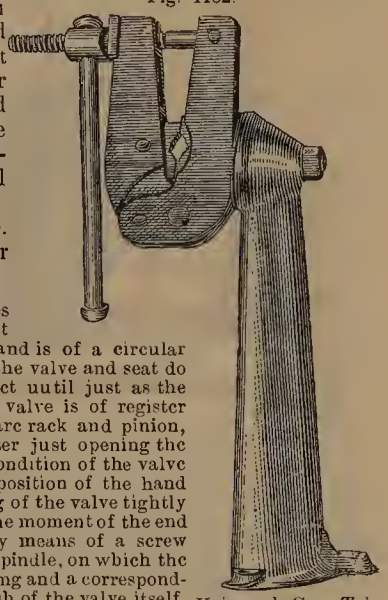
b. The gas tester used by the city of Paris is an arrangement of meter, time counter, balance, and photometer. A given amount of gas, passing in a given time, and having a certain gravity, is lighted at a burner and this is compared with a carcel burner of given power, the two lights being simultaneously observed through a tube, the field of vision of which is divided by a vertical plate. See PHOTOMETER.

Analysis and Apparatus . . "*Scientific Am. Sup.*," 2757.
Testing (Edinburgh) . . . . "*Scientific Am. Sup.*," 44.
Giroud . . . . . "*Man. & Builder*," viii. 262.
* "*Scientific Am. Sup.*," 539.
Tests, on, *Harcourt*, Br. . . "*Van Nostr. Mag.*," xv. 361.
* "*Engineer*," xlv. 240.
Transmitter, *Newman & Duesbury*, Engl. . . . . * "*Scientific Am. Sup*," 2177.
New York . . . . . "*Sc. Amer.*," xxxvii. 163.
Analysis apparatus, *Orsat*, Fr. * "*Sc. Amer. Sup.*," 3983.
Testing apparatus, *Sadler & Silliman* . . . . . * "*Engineer*," xliv. 101.
Analyzing apparatus, *Schwackhoefer*, Aust. . * "*Engineer*," xlv. 95.
Testing app., *Stevenson*, Engl. * "*Sc. Amer. Sup.*," 4004.
See also COAL TESTING APPARATUS, Fig. 651, p. 206, *supra*.

Gas Trap. A device to prevent the reflux of gas from the sewer. See SEWER TRAP.

Gas Tube Vise. One specially designed for work upon wrought iron tubes, collars, and couplings. It stands on the floor and has serrated jaw-pieces; the jaw-stock rotatable in a vertical plane.

Fig. 1182.



Universal Gas Tube Vise.

Gas Valve. A stop valve for gas mains.

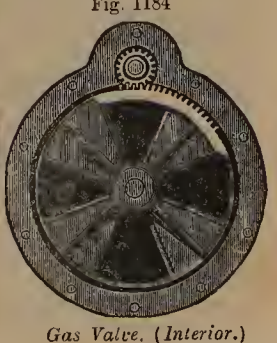
In Root's gas valves the valve seat is cast solid with the case and is of a circular form. In closing, the valve and seat do not come in contact until just as the valve is shut. The valve is of register form moved by an arc rack and pinion, one turn of the latter just opening the valve, so that the condition of the valve can be told by the position of the hand wheel. The closing of the valve tightly against its seat at the moment of the end of its motion is by means of a screw cut on the central spindle, on which the movable valve is hung and a corresponding screw on the hub of the valve itself.

Fig. 1185 shows a valve in which the parts involved in friction do not come in contact with gas. Fig. 1186 shows the Eddy valve, which is seated by a rocking bar at the back, operated by the plunger screw.

Fig. 1183.

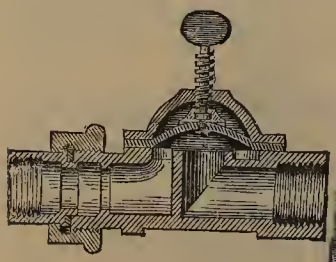
Gas Valve.

Fig. 1184



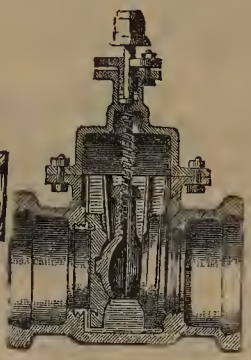
Gas Valve. (Interior.)

Fig. 1185.



Diaphragm Valve.

Fig. 1186.



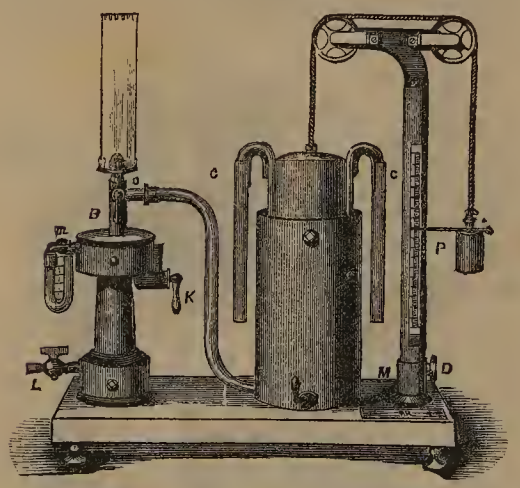
Eddy Valve.

See also, for French gas valves, article by Mallet, *Laboulaye's "Dictionnaire des Arts,"* etc., tome ii., Figs. 103, 106, cap. *"Éclairage au Gaz."*

See:
Walker . . . . . "*Sc. Am. Sup.*," * 1428, * 1439.
"*Jour. of Gas Lighting*," * 1877.
"*Scientific Amer. Sup.*," * p. 1552.
Bryan, Donkin, & Co . "*Scientific Amer. Sup.*," * p. 1526.
Mann & Owen . . . . "*Scientific Amer. Sup.*," * p. 1584.
Westwood & Wright . . "*Scientific Amer. Sup.*," * p. 1601.

Gas Ver'i-fi'er. An apparatus intended to verify whether the gas comes up to a given standard. Giroud's apparatus is shown in Fig. 1187.

Fig. 1187



Apparatus for Estimating the Value of Gas.

It consists, first, of a reservoir or gasometer, of which the movable part is balanced by a variable counterpoise *P*, to which a needle is attached moving along a scale, so as to measure the amount; 2d, of a burner inclosed in a glass chimney, and in the foot of which are three cocks, *L*, *K*, and *A*, and also a pressure-gage, *m*. It is proposed to be used in the following manner: The gas is entered at *L*, and ignited, and the height of the flame regulated by the cocks *L* and *K*, so as to be 4″ high. The cock *B* is a two-way cock, which, if the handle is turned to a horizontal position, sends the gas into the gasometer. This is then done for the space of exactly one minute, and if the gasometer is raised 5″, the gas is equal to the standard of Paris; if it has risen less it is better, if more it is inferior.

It will be seen that this manipulation is based upon trying how much gas will be consumed in one minute in order to produce a flame of given constant size, and this trial again is based upon the fact that the more inferior a gas is the more it will shorten a flame, and consequently the more be required to produce a flame of given length, and the richer a gas is in carbon the longer will be the flame, and less will be required to give a flame the standard length.

The test is thus independent of photometric experiments, by which the amount of luminosity is determined.

See also GAS TESTER, *supra*; and PHOTOMETER, *infra*.

Gas Vul'can-i'zer. A small muffle heated by gas and used in vulcanizing dental bases. The cover is secured by three set-screws, which play in a movable screw collar, and produce direct pressure upon the packing joint. The thermometer bulb is immersed in a mercury bath outside the steam chamber. Fig. 1188.

Fig. 1188.

Dentists' Iron-clad Boiler.

Gas Wash'er. (*Gas.*) A tall cylinder in which the gas is brought in contact with a falling stream of water in order to precipitate the tar.

Washers and scrubbers, Br.
Anderson, * "*Eng'ing*," xxviii. 43.
Washers and scrubbers, on, Br.
Patterson, * "*Eng'ing*," xxviii. 313.
Saville . * "*Sc. Am. Sup.*," 1026.

Gas Well. Information on gas-wells in the following: —

"Delamater"
"*Scientific American Sup.*," 1267.
"*Scientific American Sup.*," 90.
"*Scientific American Sup.*," 757.
(Pennsylvania.)
"*Scientific Amer.*," xxxvi. 196.
Wells of Pennsylvania.
"*Scientific American Sup.*," 439.
(Wyandotte). . . . . "*Scientific American Sup.*," 1427.

Gate. 1. The passage leading fluid metal into a mold.

The large opening into which the metal is first poured is termed *pouring* gate. The recess below, or in connection with the pouring gate, for skimming the iron, is termed a *skimming* gate; the little passages from the skimming gate to the mold are *sprue* gates, usually *sprues* only; those openings by which the supply of iron is kept up after the casting is poured are *feeding* gates.

2. References to gates in hydraulic works and for inclosures: —

Flood gate, *Rhea* . . * "*Scientific Amer.*," xxxiv. 278.
Flood valve drainage,
Salford, Br. . . . . * "*Engineer*," xlvii. 138.
Railway gate, *Brenton*, Br. * "*Engineer*," xlviii. 259.
Farm gate, *Cooksey* . * "*Scientific Amer.*," xxxviii. 326.
Sliding and swinging.
Shopbell . . . . . * "*Scientific Amer.*," xxxv. 179.
Gate closer, *Kohnman* . * "*Scientific Amer.*," xliii. 38.
Gate valve . . . . . * "*Man. & Builder*," xii. 88.

Gate Valve. A valve for water or gas main. A stop-valve. Jenkins' gate valve has a disk of compressible packing held to its seat by a wedge-shaped follower.

Fig. 1189.

Gate Valve.

Gat'ling Gun. The machine gun of Gatling is illustrated on pp. 249, 250, and Plate VI., "*Mech. Dict.*" See also GUNWALE GUN, *infra*.

According to time kept at a recent trial at Sealand Range, Chester, 1,000 rounds per minute were fired from a single gun.
Gun in ship's top.
* "*Sc. Am.*," xxxviii. 227.
Recent improvements.
* "*Sc. Amer.*," xxxv. 114.
* "*Sc. Amer.*," xl. 367.

Gear. 1. A combination of parts to effect an object, as lifting-gear, hauling-gear, draw-gear, valve-gear.

It is a useful word, serving as a substitute for "arrangement" or "apparatus." It is distinct from "machine" or "engine," in one direction, and from "tool" or "implement," in the other. See GEAR, p. 960, "*Mech. Dict.*"

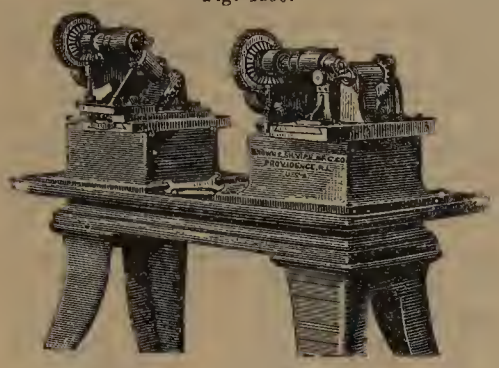
2. (*Fishing.*) A term synonymous with *tackle*: the special rig or arrangement for a given kind of fish or fishing, such as —

Deep-sea gear.
Short hand-gear.
Shark gear.
Bottom gear.
Flounder gear.
Cod hand-line gear, etc.

Gear Cut'ter. Fig. 1190 is the Brown & Sharpe automatic bevel and spur gear-cutting ma-

chine. Two machines are shown on the same stand; one is designed for cutting spur and the other bevel gears. They are specially intended for the gears of sewing-machines and other light work.

Fig. 1190.



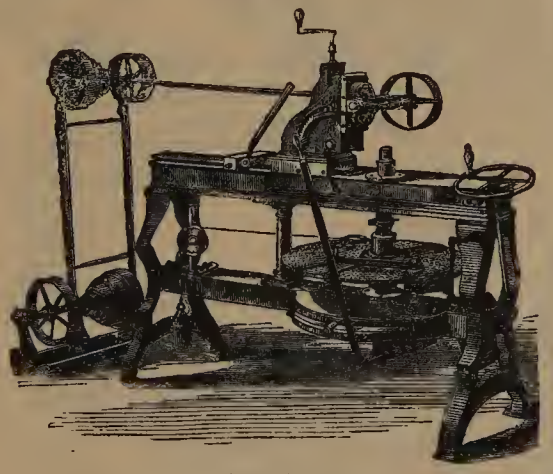
Gear-cutting Machine.

The machine is automatic to the extent of revolving the wheel from tooth to tooth, cutting through for each tooth, and stopping when the wheel is completed.

Upon the machine for bevel wheels, the movement of a lever places the wheel in position for making the second cut, when the same movements are repeated, completing the wheel. The spindles run in anti-friction boxes, provided with means for compensation for wear.

Fig. 1191 is another form of machine, adapted to cut spur, spiral, and bevel gears up to 54″ diameter.

Fig. 1191.



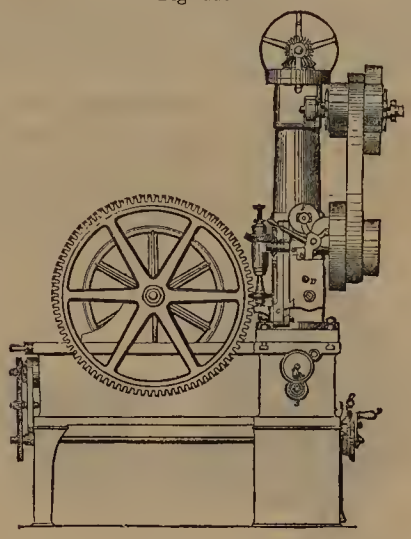
Gear Cutter.

The cutter is mounted upon shears like those of a lathe, and driven by counter gearing. The index-wheel is placed horizontally beneath the shears, and is worked by a lever.

Fig. 1192 shows Sellers' gear-cutting and wheel-dividing machine.

It is arranged for cutting both spur and bevel wheels, has a capacity up to 54″ diameter of wheel, 12″ face, and will cut a number of small spur-wheels of same size at one time. It is entirely automatic, performing all its work after adjustment, without attention of workman, to the completion of the wheel being cut or divided. The division is obtained by a tangent wheel and worm, and the designated number of teeth is obtained by use of change wheels, and the turning of the handle for change 1, 2, or 3 times, as may be called for on the schedule of division. This turning of the handle, however, and all other motions, are done by the machine itself. Thus, a blank wheel being put in place, and the proper cutter adjusted to depth of teeth, length of stroke of cutter-head, etc., the cutter will pass across face of wheel, cutting space between two teeth, will then return at a quick pace to the starting side of wheel, the blank will then be turned to present a second space to be cut, and the cutter will start its proper motion, all the changes being made by the machine itself, not by the attendant workman. The range is from 10 to 360 teeth.

Fig. 1192.



Gear Cutter.

The Corliss bevel-gear cutter, shown at the Centennial Exhibition, was used in cutting the large bevel wheels in the underground train of gearing by which power was distributed from the large engine. These motor-wheels are 6′ in diameter, weigh 3,000 pounds, have 14½″ face length of tooth, 4″ depth. The machine was illustrated in "*Harper's Weekly*," July 29, 1876.

The machine is an application of the planing machine to the purpose of gear-cutting. It has the appearance of a large quadrant, the vertical arm 14½′ high, and has also a horizontal arm, which is a mandrel carrying on its end the wheel to be cut. Midway between the vertical and the horizontal — when cutting bevel-gear having a face angle with its shaft of 45° — is an obliquc arm which carries the cutter. It looks large enough to be a piece of ordnance with an elevation of an angle of 45°. This arm has beneath it the cutting tool, which is reciprocated by rack and pinion, its effective stroke being the downward. The arm oscillates on a center coincident with the axis of the pinion which drives the planer bar.

The angle of this arm in the frame depends upon the angle of bevel to be cut, and the capacity of the machine may be said to range from 15° to 75°, though these are unusual ranges.

The bevel-wheel, having been cast in the sand with its teeth approximately the shape required, is bored out and slipped on to the mandrel, where it is secured. On the rear end of this mandrel is the wheel, 15′ in diameter, and graduated so that any proportion of a circle can be turned at a time, according as the wheel may be desired to have 60, 64, 120, 200, or any other number of teeth. In the particular instance of the miter wheels for the train of the machinery building at the Philadelphia Exhibition, the number of teeth required on the wheel was 54, and one row of holes in the face of the wheel is 216 in number, so the wheel must be moved four holes for each successive tooth, and rigidly secured by pin and clamp before cutting.

A flat plate of steel is made of exactly the contour of tooth required, certain invariable rules being observed in the shape, while certain other elements of proportion are variable, and must be determined by the *pitch*, or distance from center to center of cogs measured on a certain line, the radius of the wheel, and what not, so that the teeth shall roll nicely upon each other and not rub. This is a complex matter to determine, and then a delicate one to execute. This pattern of tooth is secured in the quadrantal or arch-shaped member of the frame, a mandrel on the end of the arm lying against it, and slipping down against the pattern as the cutter is fed along down the tooth after each stroke, the pattern swerving the arm laterally to the necessary extent. This is the adjustment for *shape of teeth*.

The *cut of the tool* is adjusted by regulating the position of a pin of the feed motion to or from the center of oscillation of an arm. At the end of each down stroke a shifting gear ships the belts and a quick *gig-back* motion results, which is again shifted to the *feed* as the planer reaches the upper end of its stroke.

In Comly's process for making pressed gearing the wheels are made of wrought iron or steel, the teeth being forged or pressed by the action of a die revolving in contact with the heated blank wheel, which also revolves at the same time.

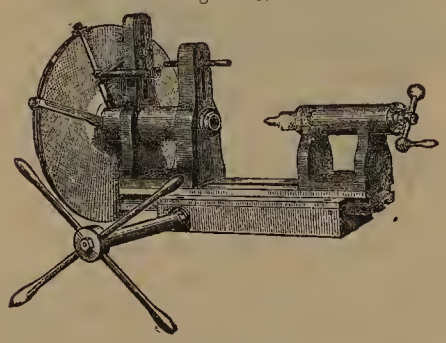
Grube's bevel wheel cutter (German), was shown in the German section of the Machinery Hall, Philadelphia, 1876.

Ingold (Chaux de Fonds, Switz.), exhibited at the same time and place his cutter for dressing the teeth of watch and clock wheels to give the epicycloidal form.

Gear-cut'ting At-tach'ment. Fig. 1193 shows Pratt & Whitney's gear-cutting attachment to the Universal Milling Machine.

It is designed for cutting larger and heavier wheels than can be cut with the ordinary apparatus belonging to the machine. It swings 13″, and is furnished with a 20″ index

Fig. 1193.



Gear-cutting Attachment.

containing 4,294 holes. It will divide all numbers to 75 and all even numbers to 150. Arbors fitted to the universal milling machine can be used in this attachment. The screw with set-nuts over the spindle supports the wheel while being cut.

Gear-cutting att. for lathes,
Mills . . . . . * "*Sc. American*," xxxiv. 166.
Sellers . . . . . "*Thurston's Vienna Report*," iii. 215.
* "*Sc. American*," xli. 54.
Brown & Sharpe . . . . * "*Sc. American*," xxxviii. 271.
Molding machine, *Scott* . * "*Thurston's Vienna Report*," iii. 321.
Cutter action, *Gleason* . * "*Sc. American*," xxxviii. 409.
Planer action, *Gleason* . * "*Sc. American*," xli. 150.
Elliptic gearing . . . . * "*Sc. American Sup.*," 21.
Regular rotary into irr. rot. * "*Sc. American Sup.*," 715.
Odontograph, *Stolp* . . . * "*Sc. American*," xxxviii. 22.

Toothed and frictional, article "*Engrenage*," * tome iv., ed. 1877, *Laboulaye's* "*Dictionnaire des Arts*," etc.

Geared Brace. A boring tool in which the drill or bit is rotated by hand crank and bevel gear.

Geared Lo'co-mo'tive. A locomotive in which the motion of the engine is conveyed by gearing to the traveling wheels. Such is common in road-rollers and traction engines. *Vide* Figs. 4360, 4361, 4363, 4364, pp. 1952, 1953, "*Mech. Dict.*" The same plan has been adopted in locomotives for ascending heavy grades.

Geared locomotives, built by Lewin, Poole, England, for Guinness & Co., Dublin, are shown in the British journals. They are for use in the brewery yard. The width of the engine is 4′ over all.

The engine has but one cylinder, $6\frac{1}{4}$″ in diameter, and with a stroke of 8″. The motion of the engine is conveyed by steel gearing to the traveling wheels, which are also of cast steel. When running at 280 revolutions per minute the speed of the traveling wheels is six miles per hour. A wrought iron clutch gear is arranged on each engine, so that they can be used for driving other machinery on the premises. The piston, valve-rods, and all pins are of steel. The engine is carried on a strong bed-plate, fixed to wrought iron brackets riveted to the boiler, and suitable provision is made to allow of the expansion of the boiler. The regulator and other gear are all on the outside. The boiler is made with double riveted longitudinal seams. The ordinary working pressure of steam is 140 lbs. per square inch. At the front end of the engine two buffers are fixed in the ordinary way, but the back or foot-plate end is made semi-circular, and is provided with a radial draw, to enable the engine to pass with the wagons round the very short curves which are frequently met with on the brewery premises; the sharpest of these is 12′ radius; the gage is 22″. There are also several inclines on the line, the steepest being 1 in 30, and up to this a load of 16 tons is frequently taken, the engines being capable of pulling a load of about 40 tons on the level. * "*Scientific American*," xxxvii. 247.

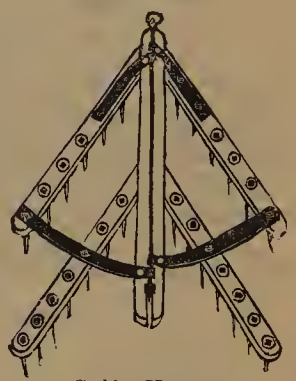
Geared Scroll Chuck. A lathe or drill chuck in which the motion of a scroll plate acts upon gears on the jaw-pieces to cause the jaws to advance and recede concertedly, preserving equal distance from the axial center of the lathe. See *g*, *i*, *k*, Fig. 1287, p. 548, "*Mech. Dict.*," and Figs. 874–876, pp. 275, 276, *supra*.

Gear Tooth Gage. A scribing and testing gage, used in connection with a gear cutter for marking the depth to which the cutter should penetrate. Gages are made for all regular pitches, from 4 to 32 pitch, inclusive, one answering for each pitch.

When using a gage for any given pitch, a slight mark can be made on the wheel opposite where the first space is to be cut, and the cutter set just to the right depth by it.

Ged'des Har'row. A field harrow made of two V's inverted, and hinged to a central bar, so as to give flexibility to the tool when passing over ridges and inequalities.

Fig. 1194.



Geddes Harrow.

A and V harrows are well-known forms and are shown under HARROW, "*Mech. Dict.*," and, compounded with circular sections, under HARROW, *infra*.

Geis'ler Tube. An instrument in which light is produced by an electric discharge in rarefied air and gases. The colors are varied by using different gases.

Prof. Morton's Lecture, "*Electric Light.*"
* "*Scientific American Sup.*," 2404, 2645.

Gel'a-tine, Blast'ing. An explosive invented by Nobel, composed of

Nitro-glycerine	94 to 95
Collodion	6 to 5

It is viscous, can be cut with a knife or scissors; is not affected by water, like dynamite, and its power is much greater,

Gelatine dynamite . . "*Iron Age*," xxii., Nov. 28, p. 5.
Blasting . . . . . "*Scientific American Sup.*," 2598.
"*Scientific Amer.*," xxxviii. 210.

See BLASTING GELATINE, 105, *supra*.

Gel'a-tine Cop'y-ing Pro'cess. A popular process for copying letters or orders, as a substitute for manifolds, is as follows: —

The original is written or drawn with thick aniline ink, generally Poirrier's "Violet de Paris," on ordinary smooth paper. Lay the writing upon an elastic cake of a special preparation contained in a shallow tray, press the paper on and take it off after two minutes. The greater part of the writing will be found to have been absorbed by the elastic cake, from which a number of reprints may be obtained, generally from 40 to 50. The cake must be wiped with a wet sponge if it has not been used for a length of time, and should always be kept in a cool place. As soon as the necessary number of copies has been taken, the writing must be at once removed from the cake by washing with cold or warm water, according to its nature, there being two different compositions, the preparation of which is described by Prof. Dr. V. Wartha, as follows: Warm a mixture of 100 grams of the finest gelatine with 400 to 500 cubic centigrams of a pasty precipitate of sulphate of baryta, and then add 100 grams of dextrine and from 1,000 to 1,200 grams of glycerine. The mass is allowed to cool until it is just possible to pour it, when it is transferred into shallow tin trays. If the cake be too hard, glycerine must be added. Another composition, which is said to yield sharper copies, but with which it is necessary to use warm water to remove the ink after use, is the following, preferred by Professor Wartha: 100 grams of gelatine, 1,200 grams of glycerine and 500 cubic centigrams of sulphate of baryta.— "*Dingler's Journal.*"

Various names have been given to the process, some of them acceptable and others absurd: hectograph, polygraph, copygraph, lithogram, etc., etc.

An excellent ink, which will yield 100 copies, is readily prepared by dissolving rosaniline in a cold, saturated solution of oxalic acid. It must be allowed to dry spontaneously.

The pad may be made of 4 oz. gelatin dissolved in 6 oz. water, and 20 oz. glycerine, sp. gr. 1.26, previously warmed, stirred in. Any air bubbles in the gelatin are removed before the addition of the glycerine. A cheaper compound which answers equally well, but is rather darker, consists of Scotch glue, 6 oz.; water, 8 oz.; glycerine, 20 oz. These qualities make a slab $10 \times 13 \times \frac{1}{4}''$.

Any number of colors may be used in the original drawing, and Mr. Norman Lockyer has suggested that it would be of much use in laboratories, for the multiplication of original sketches of biological specimens, and even for spectra charts, and so save much of the time spent in making duplicate copies.

Herr Adler's gelatine printing process is as follows:—

"Use for writing or drawing a concentrated solution of alum, to which, in order to render the writing or drawing visible upon the paper, a few drops of some aniline color is added. Before laying the writing or drawing upon the gelatine surface, pass a damp sponge over the latter, and allow the moisture to sink in for a few minutes, so as to have a greater effect upon the alum. Then lay the written side downward upon the gelatine, and after the lapse of a few minutes, on removing it, the writing will be found reversed and eaten into the gelatine film as if it were engraved. By means of an india-rubber roller a little common printing ink is spread over the plate and absorbed by the lines sunk by the alum, and rejected by the moist gelatine. The paper is laid down upon it and smoothed over it by the flat hand. When removed, this paper will have upon it the impression of the writing or drawing. For each succeeding impression the plate must be inked, as in lithography, by the india-rubber roller. A considerable number of impressions can be taken."

See:—

Houlgrave . . . . * "*Scientific American Sup.*," 2763.
"*Van Nostrand's Mag.*," xxii. 431.
Copying process . . . * "*Scientific American*," xl. 104.
Printing . . . . . "*Scientific American Sup.*," 2868
Manufacture of gelatine * "*Scientific American Sup.*," 402.

See also COPYGRAPH; HECTOGRAPH; MANIFOLD; COPYING PENCIL, and references *passim*.

Gems, Ar'ti-fi'cial. The base is strass obtained by melting together—

Carbonate sodium	6 drachms.
Burnt borax	2 drachms.
Saltpeter	1 drachm.
Minium	3 drachms.
Pure white sand	1.5 oz.

To color, add: for the gems named—

Sapphire	10 gr. carb. cobalt.
Opal	10 gr. ox. cobalt. 15 gr. ox. mang. 25 gr. protox. iron.
Amethyst	5 gr. carb. perox. mang.
Gold topaz	30 gr. ox. uranium.
Emerald	20 gr. protox. iron. 10 gr. carb. copper.

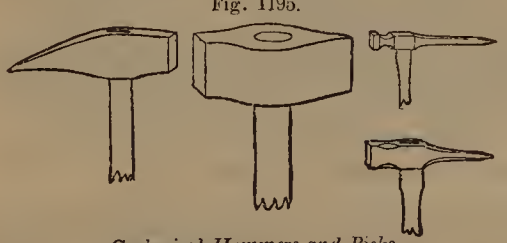
Composition, see "*Manufact. & Builder*," xii. 240.
"*Scientific American*," xxxvii. 149; xxxiv. 276; xxxviii. 2, 47.
"*Scientific American Sup.*," 1593.

Ge'nu-val'gum Brace. (*Surgical.*) Leg braces, to correct or support knock-knees. See LEG SUPPORT, *infra*.

Figs. 74, 197, Part IV., *Tiemann's "Armam. Chirurgicum."*

Ge'ode. (*Mining.*) A cavity studded with crystals or mineral matter; a rounded stone containing such a cavity.

Fig. 1195.



Geological Hammers and Picks.

Ge'o-log'i-cal Ham'mer. One for hewing hard rocks, or for extracting fossils from rocks. The larger sizes are for breaking and crushing, and the smaller for trimming. See Fig. 1195.

Ge'o-met'ric Lathe. Elaborate illustrated article on geometric lathes, the applications to engraving, medaling, and turning, 43 illustrations, article "*Tours Composés*," Figs. 25, etc., *Laboulaye's "Dictionnaire des Arts et Manufactures*," tome iv. See also GEOMETRIC LATHE; ROSE-ENGINE LATHE, "*Mech. Dict.*"

Ge'o-scope. An instrument to demonstrate the movement of the earth. *Mancel de Percival. "Technologiste,"* xl. 470. See also ARMILLARY SPHERE; COSMOSCOPE; ORRERY; TELLURIAN, etc.

Ger'man Sil'ver. The recipes given vary greatly in proportions, while still generally preserving the trinary composition.

Kirk gives the following; which compare with recipes on pp. 63, 964, "*Mech. Dict.*:"—

	Copper.	Nickel.	Zinc.	Iron.
German silver . .	80	20	33.5	–
Better	100	50	50	–
White copper Chinese packfong	41	17	13	1
Hard	8	2	4	1
Harder	16	4	8	3
Finest	16	8	7	–

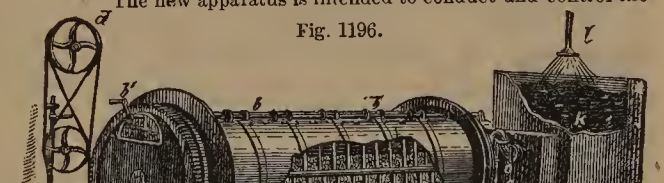
Analysis . . . . . "*Scientific American*," xxxv. 166.
Compositions . . . . "*Iron Age*," xxi., March 14, p. 5.

Ger'man Steel. (*Metallurgy.*) A metal obtained from spathose or bog ore by treatment with charcoal.

Ger'mi-na'tion Ap'pa-ra'tus. An apparatus invented by M. Gruber, in which the malting of grain is conducted; including the steeping, couching, and flooring; the kiln drying is a subsequent process. See MALT DRYER; MALT MILL, etc.

The new apparatus is intended to conduct and control the process by mechanical appliances, so as to altogether dispense with manual labor in turning the grain over on the germinating floor. An artificial ventilation is effected by means of a current of humid air passing downward through the grain. This ventilation keeps the mass at a relatively low degree of temperature (54° F. to 56° F.), and at the same time draws off the carbonic acid gas as fast as it is produced. Moreover, the thorough turning over of the grain, and its complete division by the periodical rotation of the cylinder, in which the germination takes place, insure a most regular and uniform development of both rootlets and plumule.

Fig. 1196.



Germination Apparatus.

Fig. 1196 shows the apparatus. It consists of an iron cylinder, which by means of an endless screw receives a slow rotatory movement. The letters refer to the following parts:

b. Longitudinal openings for charging and emptying the apparatus.

b'. Handle for opening and closing the above.

c. Sheet-iron gratings for admission of moistened air.

d. Mechanical appliances for giving motion to the cylinder.

e. False bottom of perforated sheet-iron supporting the grain, and through which the air is drawn downwards.

f. Pipe for drawing out the air.

g. Tap for admitting and drawing off the steep water.
h. Exhaust chest.
i. Fan.
k. Chamber for moistening the air by filtering it through porous substances kept constantly saturated with water.
l. Shower of water on the moistening chamber.
o. Valve for regulating the draft of air.
p. Rake for dividing the layers of grain during the rotation of the cylinder.

Gruber . . . . * "*Scientific American Supplement*," 2686.
* "*Scientific American*," xxxvii. 152.

Ges'ten-ho-fer Fur'nace. One in which the burning of the sulphur from the powdered ore accomplishes its calcination.

The sulphurous vapor is used to make sulphuric acid, and the acid employed to make soda from common salt.

See notices under CALCINING FURNACE, p. 152, *supra*.

Gibbed Lathe. A lathe the carriage of which has a bar which grips beneath the overhang of the bed, beneath which it is secured by a wedge known as a *gib*, to prevent the riding up of the carriage.

In a *weighted* lathe, on the contrary, the carriage is held down upon the shears by a weight suspended beneath the carriage.

Gif'fard In-ject'or. See INJECTOR.

Gild'ing Press. A book-binder's press, for gilding covers and edges of books.

The edges of books, and hand-work on backs and covers, is done while the book is clamped in a press, 3, Fig. 1578, p. 668, "*Mech. Dict.*"

On a larger scale the full-arch or half-arch press is on the principle of 1, Fig. 1577, *Ibid.*

Gild'ing. Attaching an overlay of gold.

Gilding by dipping. — Dissolve 10 grams of gold in 40 grams of hydrochloric acid, and 15 grams of nitric acid; throw down the gold as fulminating gold by means of spirits of ammonia; filter, and wash. In the mean time dissolve 100 grams of cyanide of potassium in as small a quantity of water as possible, and then dissolve the gold upon the filter with the cyanide solution. Pour this solution again and again over the filter until all the brown particles are dissolved, when the gilding solution is prepared by the addition of 1 liter of distilled water. Into this solution, while warm, dip the metallic object to be gilded, and when drawn out it will have all the appearance of polished gold. — *Ebermeyer.*

Gilding on Glass. — Gold, chemically pure, is dissolved in aqua regia (1 part nitric, and 3 parts hydrochloric acid). The solution effected, the excess of acids is evaporated on a water-bath till crystallization of the chloride of gold takes place; it is then taken off and diluted with distilled water of such quantity as to make a solution containing 1 grain of gold to 200 cubic centimeters of liquid; a solution of caustic soda is then added until the liquid exhibits an alkaline reaction. The solution of gold is now ready for reduction. As a reducing agent, an alcoholic solution of common illuminating gas is used. This is prepared by simply attaching a rubber tube to a gas-jet and passing the current of gas for about an hour through a quart of alcohol. This liquid (which should be kept in a closed vessel) is added in quantities of from two to three cubic centimeters to 200 cubic centimeters of the alkaline solution of gold before mentioned: the liquid soon begins to turn to a dark green color, and at length produces the metallic layer of gold of known reflecting power. — *Dodon* in "*Moniteur de Ceramique.*"

Designs or ornaments of any kind can be produced on glass or ivory, by painting, with a very fine camel-hair pencil, nitro-muriate of gold over the designs. Hold the glass or ivory thus painted over a bottle, in which hydrogen is being generated; in a short time the design will shine with considerable brilliancy, and will not tarnish upon exposure to the air. The thickness of the coating of gold is not more than the ten millionth part of an inch. Another method, in which the use of hydrogen is dispensed with, is to mix gold powder with borax and water; then paint the lines and ornaments with it. When quite dry, the glass is to be put into a stove, heated to a high temperature. The borax is vitrified, and cements the gold with great firmness to the glass. — "*English Mechanic.*"

See: Glass . . "*Scientific American*," xlii. 42; xxxix. 104.
Dodson . . "*Min. and Scientific Press*," xxxvii. 407.
Iron Work . "*Iron Age*," xvii., April 20, p. 15.
"*Scientific American*," xxxvi. 291.

Gill Net. (*Fishing.*) A flat web net fastened at one or both ends, and arranged by floats and weights carefully proportioned to float near the surface of the water, at an intermediate depth, or at the bottom.

When it floats with the tide it is called a *drift* net.

The gill-net captures a fish by entangling it in its meshes.

The gill-net of Lake Michigan, and salmon-net of the St. Lawrence, are shown on pp. 256, 257, "*Report of U. S. Commissioner of Fish and Fisheries*," vol. i., Part I., 1873.

The *stake*-net is a form of gill-net.

The gill-nets for white fish, used on the Great Lakes, may serve as an instance.

"The gill-netting in use on the Great Lakes is knit from linen thread, two and three ply (25-4, 2-cord, and 30-50, 3-cord), from eleven to twenty-two meshes in depth, $3\frac{3}{4}$ to 5″ mesh. The nets, when hung or mounted for use, contain from one to three pounds of webbing, and range in length from 60 to 120 yards, and in depth from $4\frac{1}{2}$′ to 6′. They are set in gangs of from three to five nets, and three to five gangs are laid out in one setting usually by aid of sail-boats or steamers.

"For floating the upper line, round or octagonal floats of bark, or wooden pickets about $2\frac{1}{2}$′ in length, are used. Sinkers are of lead or stone. The nets are set in from 20 to 100 fathoms of water, the lead-line resting upon the bottom. They are taken out once a week and dried.

"They are used principally for the capture of the white-fish (*Coregonus albus, etc.*), and the lake trout (*Salmo namay cush*), though most of the common lake fishes are taken in these meshes. Sea-Island cotton (3, 4, 5, and 6 thread) is being largely substituted for linen in their manufacture.

"The weight of the twine preferred by fishermen varies in different localities, that used in Green Bay being the finest, that in Lake Erie next, then Lakes Michigan and Superior, and heaviest in Lake Huron. Lake Ontario consumes about 5,000 pounds of netting annually, Erie 7,500, Huron 6,000, Michigan 20,000, Green Bay 2,500, and Lake Superior 5,000. The aggregate length of this netting is probably about 4,575,000 yards." — *Bulletin U. S. National Museum.*

Gin. Cotton gins are of four principal kinds, the *roller*, *comb*, *saw*, and *needle* gins. The comb is Spanish (*almarraes*), and has mechanical importance.

The roller gin is found throughout India, Malaysia, and China, and has received its proximately perfect development in the Macarthy gin and its relatives.

The Macarthy double roller gin made by Platt Bros., of Oldham, England, has, as its name implies, two rollers instead of one, the feeding hopper being between the two. In the familiar Macarthy gin a reciprocating blade is employed in conjunction with a fixed blade and roller, but, in this later form of gin, two reciprocating blades come into action alternately. A simple contrivance regulates the feeding, making it uniform, and another regulates the pressure of the knifes, called in the American Macarthy gin, *stripper blades*, so as to adapt them to the work of the moment, and allow an obstruction to pass through without clogging or arresting the machine, or breaking the knife or stripper-bar.

The rollers are covered with walrus leather, far more durable, and, from its peculiar texture, superior to sole leather. Each roller rotates in contact with a fixed knife, dragging by its rough surface the fibres of cotton between itself and the knife. Besides these parts there are moving knives, to each of which is attached a grid, or series of fingers. At each elevation of the moving knives, which rise alternately, the grids attached thereto lift the cotton to the elevation of the fixed knife edge and of the exposed surface of the rollers. On the descent of each moving knife the seeds which have been separated from the fiber are disentangled by the prongs of the moving grid passing between those of the lower or fixed grid about 750 times per minute, and are, by this rapidity of action, flirted out.

The turn-out is from 120 to 190 pounds of cleaned cotton per hour. The machine was shown in operation at the Paris Exposition of 1878. It was there stated that 10,000 of the double Macarthy gins were in use in India; and 5,000 of the single Macarthy in Egypt.

The double action knife roller gin is made by Dobson and Barlow, of Bolton, England.

It is entirely self-feeding and self-acting, and the motion for detaching the cotton from the seed differs from that in any other make of gin. The leathern roller is solid, being

composed of round disks of walrus leather with a square shaft through the center. These disks are pressed together mechanically with so much force that when withdrawn from the pressure they form a perfectly solid body. The knife-roller consists of a number of disks fitted obliquely on a wrought iron shaft; it revolves continuously in one direction, the knives gently moving the seeds to and fro while the leathern roller draws the cotton from them until the seeds are perfectly stripped, when they fall unbroken into a receptacle provided for them on one side of the machine, while the cotton is delivered in a continuous fleece at the other side.

When worked at the prescribed speed, a 40″ knife-roller gin is capable of ginning the following quantities of seed-cotton per hour. —

Dhollerah, 300 lbs.
Candeish, 333 lbs.
Madras, 307 lbs.
Dharwar-American, 230 lbs.
American uplands, 329 lbs.
Egyptian, 600 lbs.
Sea Island, 387 lbs.
Brazilian K, 460 lbs.
Tinnevelly Madras, 500 lbs.
Broach, 348 lbs.
Native Indian (various), 820 lbs.

These results were obtained from this knife-roller gin, at the trials in Manchester and India under government auspices. The double-action knife roller gin can be adapted for any kind of cotton by a change of the grid through which the seeds have to fall, and it has the merit of simplicity in construction and adjustment, large turn out of clean cotton uninjured, and having neither crank nor cam motions.

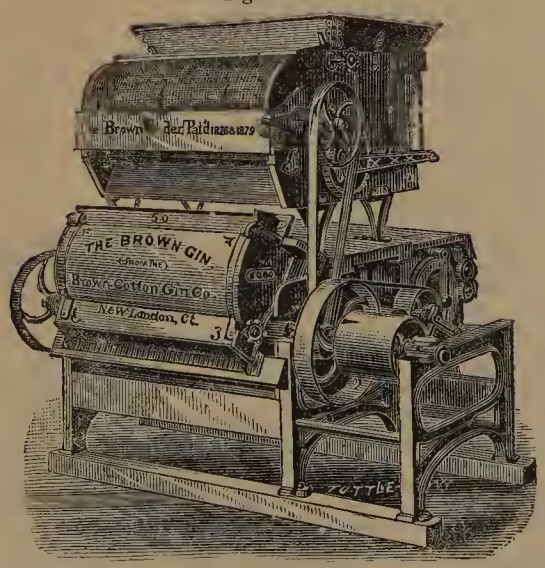
These gins are made of various sizes, with rollers 10″ long, to be worked by hand; 20″, 30″, and 40″ wide, to be driven by power.

The cleanness of work, and avoidance of damage to the staple secured by the Macarthy gin, and the large turn out of the saw-gin, are claimed to be united in this knife roller gin.

Fig. 1197 shows the Brown Saw Gin, with feeder and condenser.

The cotton is dumped into the hopper of the feeder, and is taken up by teeth on a revolving drum that runs in the semi-circular front, carried over and dropped into the hopper of the gin upon the saws that are revolving at a speed of 375 revolutions per minute. These saws run between grates or

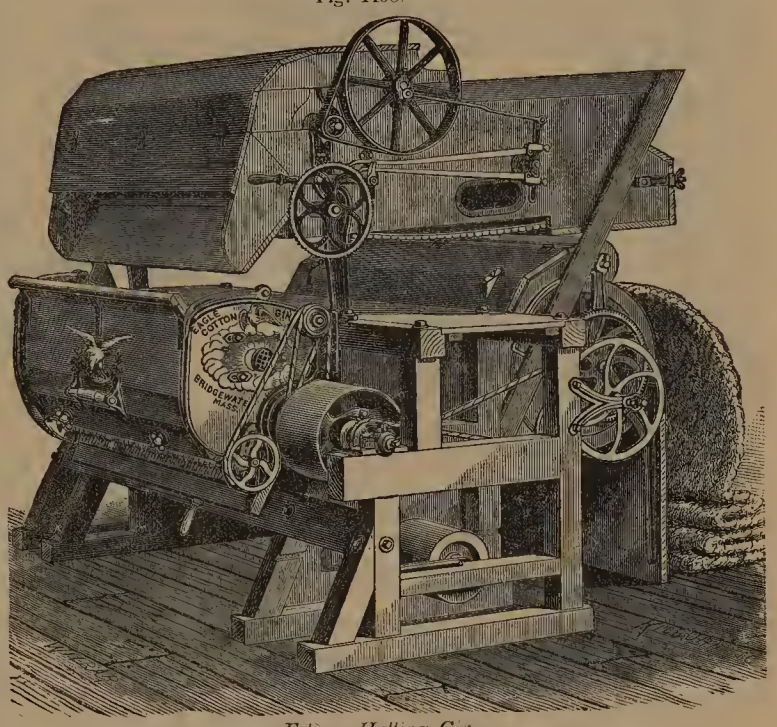
Fig. 1197.



Cotton Gin Feeder and Condenser.

bars that are set say $\frac{1}{8}$″ apart, and pick the cotton from the seed, carrying the lint cotton between the bars, where a brush is revolving at a speed of about 2,400 turns per minute. This brush wipes the cotton from the teeth of the saws, and it is carried by the current of air (caused by the revolving brush) into the condenser at the rear, when it passes between two wooden rollers and is dropped upon the floor in a pile. The saws number from say 30 to 80 in a gin, the average being about 50.

Fig. 1198.



Eclipse Hulling Gin.

Fig. 1198 shows the Eclipse Hulling Gin, for working upon cotton gathered with the bolls. It consists of three parts, feeder and breaker, gin, and condenser.

The feeder and breaker, which is the upper member of the complete machine, is used to break the bolls apart before ginning, as well as to feed the gin. It has a strong, rapidly revolving cylinder with blunt points, to bring the cotton to the breast. This runs parallel with another cylinder, moving more slowly, and having wires in it bent backward. Between the two cylinders the cotton is well opened, and all the whole bolls are broken apart, putting them in such condition that the gin will easily discharge them, and at the same time knocking out a large amount of leaf and dirt. This machine picks its cotton on the under side instead of the top, as has heretofore been done.

Fig. 1199.

Eagle Cotton Gin. Sectional View.

The principle of action is described, and several illustrations are given of cotton gins, on p. 969, "*Mech. Dict.*" Fig. 1199 shows a sectional view of the breast, huller, gin-saw, and brush of the "Eagle" Cotton-gin.

The cotton is fed into the outer breast and drops upon the huller roller (*B*), and is carried by it constantly to the saws. The hulls are stopped by the projections from the ribs and the cotton is carried between them and into the inner breast, where it is ginned.

When the gin is fed by hand the inner breast is kept covered with a hinged flap so that the cotton may be pulled over it from the top of the gin. When a feeder is used, as in the perspective view, Fig. 1198, the flap is turned back so as to leave the breast open.

The Clement gin cards from the boll without breaking or tangling the fiber; avoids the separate ginning, and passes the lint from the seed to the condition of thread. Much stress is laid upon the avoiding of twisting and mixing the fiber heterogeneously, and the damage due to pressure in the bale.

The Gullett "Magnolia" Gin claims as a specialty a stationary beater consisting of 6 parallel bars in close proximity to the brush. This beater consists of thin straps of steel, running the whole length of the saws, and to which the cotton is carried, after leaving the saws, and over which it is thoroughly whipped and cleaned of dust and dirt by the brush.

The Scattergood needle-gin has needles instead of saws. The circles of needles consist of 10 segments, each removable for replacement.

Gin Block. A simple form of tackle-block, having one wheel over which a rope runs.

It has local names, such as *whip-gin*, *rubbish-pulley*, *monkey-wheel*. See Fig. 2225, p. 969, "*Mech. Dict.*"

Ging'ham Loom. A typical form has 2 harnesses and 4 boxes at each end of the lathe. Works pick and pick, and from 1 to 7 colors of filling; any shuttle can be brought into action, and any box can be skipped. Shuttle-boxes can be operated 135 to 145 picks per minute. Stop motion devices on each end stop the loom when any filling is exhausted. —*Crompton.*

Gin Pow'er. An adaptation of the horse-power to the working of a cotton gin. Usually in a story below the gin-house floor.

Gin Pul'ley. See GIN WHEEL.

Gin Wheel. (*Mining.*) A pulley for the lifting cord of the bucket used in sinking shafts. It has a swivel hook and wrought-iron frame.

Gi-raffe'. (*Mining.*) A form of cage or truck used on inclines in mines of the Pacific slope.

Gird'er Riv'e-ter. A form of riveting machine, preferably hydraulic, and suspended so as to work along the girder.

See RIVETING MACHINE, *infra*. Also, Fig. 4351, p. 1949, "*Mech. Dict.*" See KEEL RIVETER, *infra*.

* "*Scientific American Supplement*" . . 2225.

Girth Stretch'er. A frame in which saddle girths are suspended and held taut "to take the stretch out of them," as it is called.

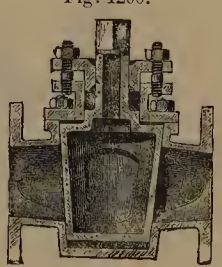
Spring saddle girth, Br. . . * "*Engineer*," xliii. 73.

Gla'ci-a'ri-um. A skating rink, with ice artificially frozen.

That at Chelsea, London, is described, with the refrigerating apparatus, in "*Engineer*," * xli. 378, 381.

Gla'cis. A glancing defense on the deck of a monitor or turret vessel to deflect a ball. See TURRET.

Fig. 1200.



Gland Cock.

Plate XXIV., *Barnard & Wright's "Report on Fabrication of Iron for Defensive Purposes,"* U. S. Engineers, 1871.

Glacis and turret of "Inflexible," * "*Scientific American Sup.*," 122.

Gland Cock. A faucet held in place by a gland which can be removed to get at or pack the plug.

Glass. Subjects in GLASS are considered under the following heads: —

Aggry.	Glass press.
Annealing.	Glass shade.
Aventurine.	Glass silk.
Battledore.	Glass silvering
Bead.	Glass, Tempered.
Black glass.	Glass tile.
Blowing furnace	Glass, Toughened.
Blow-pipe.	Glass type.
Bohemian glass.	Half-clear.
Bottle glass.	Half-crystal glass.
Bottle making.	Hardened glass.
Bronzed glass.	Hot cast porcelain.
Bullion point.	Hyalithe.
Cameo glass	Illuminated sign.
Cameo incrustation.	Iridescent glass.
Casing.	Iridiated glass.
Cinder wool.	Lime glass.
Chair.	Marbleized glass.
Clear.	Marver.
Colored glass.	Melting furnace.
Compressed glass.	Metal.
Crown glass.	Metalized glass.
Cryolite glass.	Mineral wool.
Crystal.	Mosaic glass.
Cullets.	Mousselaine glass.
Cuvette.	Murrhine glass.
Cylinder glass.	Muslin.
Deglazing.	Nickel plating.
Devitrification.	Onyx glass.
Diamond, artificial	Opal glass.
Direct fire.	Optical glass.
Doubled glass.	Painting on glass.
Drawing.	Paper-weight.
Enamel.	Patent plate.
Enameled glass.	Pencil.
Enameling.	Pincher.
Engraved colored glass.	Plastic crystal.
Engraving.	Plastic etching.
Etched enamel.	Plate-glass.
Etching.	Platinizing glass.
Etching ink.	Ponty.
Filigree glass.	Pot.
Flashed glass.	Pressed glass.
Flattening furnace.	Pucellas.
Flattening oven.	Punty.
Flattening stone.	Rolled plate-glass.
Flattening table.	Rose glass.
Flint glass.	Ruby glass.
Flocked enamel.	Safre.
Fluted glass.	Shade.
Furnace-slag glass.	Shears.
Gas furnace.	Sheet glass.
Gems, artificial.	Silicate cotton.
Gilding on glass.	Silvering glass.
Glass-blower's pump.	Silver glass.
Glass-blower's tools.	Slag glass.
Glass blowing.	Slag wool.
Glass carving.	Soap.
Glass coloring.	Soluble glass.
Glass cutter's frame.	Spring tool.
Glass cutting.	Spun glass.
Glass cutting machine.	Strass.
Glass decorating.	Table.
Glass drilling.	Tempered glass
Glass, enameled	Tissue glass.
Glass engraving	Tongs carriage.
Glass etching.	Toughened glass.
Glass flooring.	Vulcanized glass.
Glass furnace.	Wheel engraving.
Glass milestone	White glass.
Glass mold.	Window glass.
Glass polishing machine.	Zaffer.

A glass has lately been made with phosphate of lime, by M. Sidot. He states that it is perfectly transparent and very refrangent (its index of refraction is 1.523, that of common glass being 1.525); and it can be worked like ordinary glass. It does not, like ordinary glass, dissolve all metallic oxides, but it dissolves very well oxides of cobalt and chromium. It is attacked by boiling acids, as also by potash; it is not attacked by hydrofluoric acid; and this property may render it valuable in connection with telescope glasses, for workmen who are exposed to these vapors, and who have to work in the art of engraving on glass.

According to Mr. Robert Hunt's experiments, on the effect of colored glass upon plants, the germination of seeds is prevented and young plants soon die when exposed to yellow light. With careful attention, red glass induces a sickly growth, but the leaves become partially blanched. Young plants seem to avoid the red by bending away from it, but as they arrive at the flowering stage, prefer it to blue or yellow. Blue promotes the germination of seeds and the growth of young plants, but after a certain time seems to increase the bulk rather than the strength.

Oxide of manganese when present in glass tends to correct the coloring action of the iron usually found in the sand, but

allows a greater amount of heat to pass than does common glass and is consequently injurious. Mr. Robert Hunt, therefore recommended that glass be tinted with oxide of copper, which was done in the case of that employed for glazing the palm-house at Kew, with advantageous results.—"*Curiosities of Art and Literature.*"

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"*Iron Age*," xxii., July 25, p. 1.
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"*Sc. American Sup.*," 1940.
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Materials . . . . . p. 312
Crystallization and dentrification . . . . p. 316
Action of acids and alkalics . . . . . p. 319
Analysis . . . . . p. 321
Pot-making-bricks . . . . . p. 324
Fire-bricks . . . . . p. 326
Plate glass . . . . . p. 328
Tempered glass . . . . . p. 337
Compressed glass . . . . . p. 340
Soluble glass . . . . . p 341
Window glass . . . . . p. 344
Flattening oven . . . . . p. 348
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Colored sheet glass . . . . . p. 350
Glass shades . . . . . p. 352
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Dominique Bussolin.
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Glass Bar'rel Pump. A pump made by Appleby, and used in breweries for raising hot wort, in gas works for ammoniacal liquor, in tan-yards for tan liquor, in drainage works or farms for sewage, in paper-mills for paper pulp and bleach, and in chemical works for strong acids, etc.

Fig. 1201.

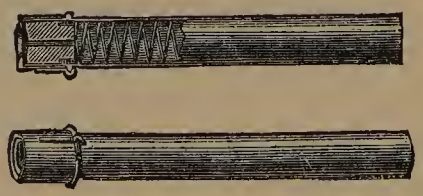
Glass Barrel Pump.

To suit the various circumstances under which it has to work, the mountings of the pump are made either of cast iron, lead, or gun metal, whichever may be best suited to the liquor to be dealt with. The glass working-barrel is accurately bored and highly polished. The mountings are arranged with flanges for coupling up to the suction and delivery pipes, and are held together by wrought-iron screwed bolts or stretchers, with double nuts at each end. The valves are solid india rubber, with lips which open and close. When it is intended to pump hot liquids it will be necessary to place the pump below the liquor, otherwise the steam evolved will prevent the creation of a vacuum in the cylinder. For thin liquids the pumps may be run at a high speed, but for dealing with thick fluids it is advisable to adopt a low speed.

Glass-blow'ers' Pump. A device for injecting air into a glass globe or cylinder while being formed; a substitute for the breath and the power of the lungs.

It was invented by *Robinet*, of Baccarat, and is shown in Fig. 1202. It consists of a small cylinder of sheet brass, closable at one end, in the interior of which is a steel spring;

Fig. 1202.



Glass-blowers' Pump.

at the lower end is a wooden piston, with an opening faced with leather, and held by a bayonet-joint thimble. The mouth of the *ponty*, the pump being held vertical, is placed in contact with the piston, the air contained in the cylinder is by a sudden blow injected through the ponty into the piece of glass being fabricated, and expands therein by the heat of the glass.

Glass-blow'ers' Tools. (*Glass.*) Ponty (blow-pipe), pinchers, shears, calipers, marver (iron plate), bench, and a few other primitive tools.

Glass tools, nickel plated, *Clémandot*, "*Man. & B.*," viii. 253

Glass Carv'ing. A mode of ornamenting glass by etching and chiseling. The most remarkable instance is the "Portland," otherwise known as the "Barberini," vase. Long supposed to be an onyx, then considered ceramic.

A modern remarkable success in the same line is the "Dennis Vase," by Webb & Sons, shown nearly complete, at the Paris Exposition of 1878.

See "*Report on Paris Exposition*," 1878, vol. iii., pp. 237, 274.

"The body of this vase is of a very dark blue and coated outside with opal glass. The subject chosen by the artist, Mr. Northwood, is the Triumph of Galatea and Aurora. The cover represents a winged horse, not yet finished. The two handles represent horses' heads, one of which is finished. The subjects shown upon the sides, the base, and foot, are ornamented with leaves in opal. The immense difficulty of producing such an article will be understood when it is considered that all the designs in relief have to be carved and chiseled out of the white outside coating; the artist is required to produce a semi-translucid effect, showing the blue glass through the opal, carving out this glass and making it thin enough to show the blue through and yet retain perfect and correct relief forms. This beautiful effect was reproduced in several parts of the vase. The blowing of the vase itself must have been a difficult piece of workmanship, since the horse on the cover and the horse-head handles must have been so put on as to enable the artist to carve correct subjects and introduce the semi-transparent tints I have alluded to. This glass carving is necessarily a very slow work; the vase is not yet finished, some parts being polished and others yet in the rough state. The artist has already devoted two years to the vase, and it is estimated it will be worth $15,000 when finished. It is simply a '*tour de force*.'" —*Colné* (1878).

Glass Ce-ment'. See Recipes, CEMENT, p. 182, *supra*.

Glass Cut'ting. (*Glass.*) There are four kinds of wheels used in cutting or engraving glass: —

1. Cast or wrought-iron wheel.
2. Stone wheel of close grain.
3. A wooden wheel.
4. Cork wheel.

The iron wheel, being mounted in a frame, is rotated, and over it is a drip hopper containing sand and water, which run on to the glass object being cut. The sand cuts away the glass roughly.

The glass is then applied to the stone wheel, which removes the asperities caused by the roughness of the previous process.

Next the glass is applied to the wheel of poplar or willow wood, treated with wet pumice-stone powder. This removes scratches.

The polish is given by the cork-wheel, with *tin putty* (p. 1836), or *colcothar* (p. 593), "*Mech. Dict.*"

A simple way of cutting glass is to crack it with a very fine needle-like gas flame. Start the crack with a file, and then apply the flame, which may be produced through a minute perforation in a glass connected with some rubber piping so as to allow of the flame being conveniently carried from point to point. The crack will run before the flame in any desired direction.

Glass Dec'o-ra'ting.

Carving.	Incrusting.
Coloring.	Painting.
Cutting.	Platinizing.
Enameling.	Silvering.
Gilding.	Etc.

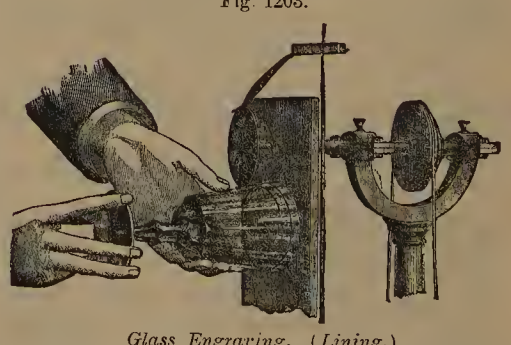
See list under GLASS, p. 400, *supra;* also pp. 975, 976, "*Mech. Dict.*"

See also *Laboulaye's* "*Dictionnaire des Arts*," etc., article "*Verre*," vol. iii., ed. 1877.

Glass En-grav'ing. The Figs. 1203, 1204, show the lathe and manner of using in lining and lettering glass ware, respectively.

As to the former, a wooden gage is placed behind the cut-

Fig. 1203.



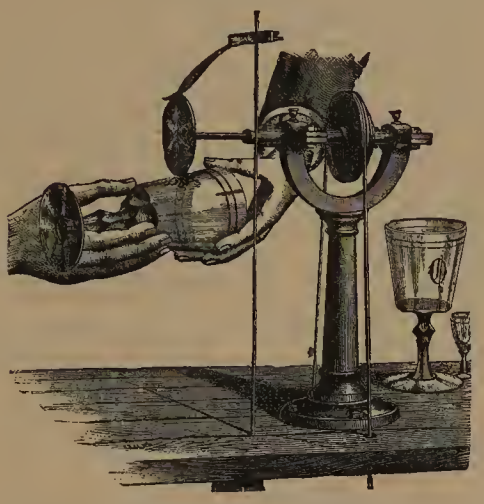
Glass Engraving. (*Lining.*)

ting wheel to regulate the distance of the line from the edge of the vessel. A little washed flour emery, mixed with olive

oil, is applied to the periphery of the wheel, the latter being revolved at a moderate speed. By pressing the goblet against the gage, and at the same time holding it lightly against the wheel and turning it slowly, a line will be formed around it. The wheel is occasionally retouched with emery and oil.

In lettering and ornamenting, the design is first drawn with a pen or brush, charged with a mixture of gum-water

Fig. 1204.



Glass Engraving. (*Lettering.*)

and whiting; the lines are then followed by the appropriate wheel charged with emery flour and oil. Small wheels are used for small work and for short curved lines, while the larger wheels will be used in making large curves and straight lines. The engraved work may be polished with leaden wheels, applying pumice-stone and oil.

"The surface of a plate of glass or crystal having been covered with a concentrated solution of nitrate of potash, and a horizontal platinum wire, connected with one of the poles of an electric battery, being placed in the liquid along the edges of the glass, any design may be easily drawn on the glass by touching it with the point at the other end of the platinum wire. The wire forming the 'pencil' is insulated, the tip alone remaining uncovered, and by simply using the wire as an ordinary pencil and tracing imaginary lines on the surface of the glass, the design is permanently reproduced and distinctly engraved thereon. Flat surfaces may be easily treated in this manner, but the difficulty of keeping convex surfaces covered with the nitrate of potash is likely to prove an obstacle to the general adoption of the system. By means of a specially constructed bath, however, it may be possible to overcome the difficulty." — *Planté.*

Engr. by electricity, *Planté*. "*Telegraphic Journal*," vi. 32
Sand-blast, *Tilghman* . . * "*Scientific Am.*," xxxvii. 120.
And depolishing, *Matthewson* "*Technologiste*," xli. 7.

Glass Etch'ing. A ground, or invisible alcohol varnish is laid on glass on which designs or scales may be drawn by means of points: —

Alcohol . .	100
Mastic . .	7
Sandarac .	3

Terquem, "*Journal de Physique*"

An elaborate article on grounds transferring and etching was reproduced from "*Dingler's Polytechnic Journal*" in the "*Scientific American Supplement*," p. 103

The fluoric acid process is described in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," cap "*Verre*," tome ii., ed. 1877.

Glass Eye.

The workman is provided with a number of thin glass rods, of the colors required. Heating the end of one of them by means of a blow-pipe, he gathers from it sufficient for his purpose, on the end of a wire. This first gathering is generally of white or colorless glass, to form the white of the eye. He then takes the rod required to form the iris, and gathers from it on the white, and lastly, a little spot from a black rod is added to form the pupil. During the process the bulb on the end of the wire is rotated in the flame of the blow-pipe and occasionally pressed against a smooth surface to obtain perfect evenness of outline.

Glass Floor'ing. Glass tiles.

Flags or slabs of rough-cast glass are manufactured in pieces 6″ broad, $1\frac{3}{8}$″ thick, 11″ long, and weigh 165 lbs per square meter; the upper surface is generally molded in diamonds. Pavements of glass are made in the same style as the slabs, with the upper surface molded in diamonds, but are much thicker, and are intended for slabs for carriage-ways. They are made of cubes of about 6″ × $6\frac{1}{2}$″, and weigh each 19.80 lbs. Rough slabs are also made of 6.56′ × 2.65′, varying in thickness from 9-16″ to $1\frac{1}{2}$″; weight, from 213 to 492 lbs.

Glass Fur'nace. The use of Siemens' furnace in glass furnaces has proved a great success. The principles of the furnace are described under GAS-GENERATING FURNACE and REGENERATOR FURNACE.

Fig. 1205 shows the application to glass-making *A* is the furnace, on the siege of which the pots *B B* are placed *C* are the openings through which the contents of the pots are reached. Under the furnace floor are disposed 4 regenerators, of which but one, *D*, shows in the longitudinal section These, as is explained under the heads cited above, are used in pairs alternately: (1) heated by the gases passing from the furnace to the chimney, and (2) serving to heat the inflammable gases from the gas producer, and the incoming air, which mingle just before reaching the pot furnace *A*.

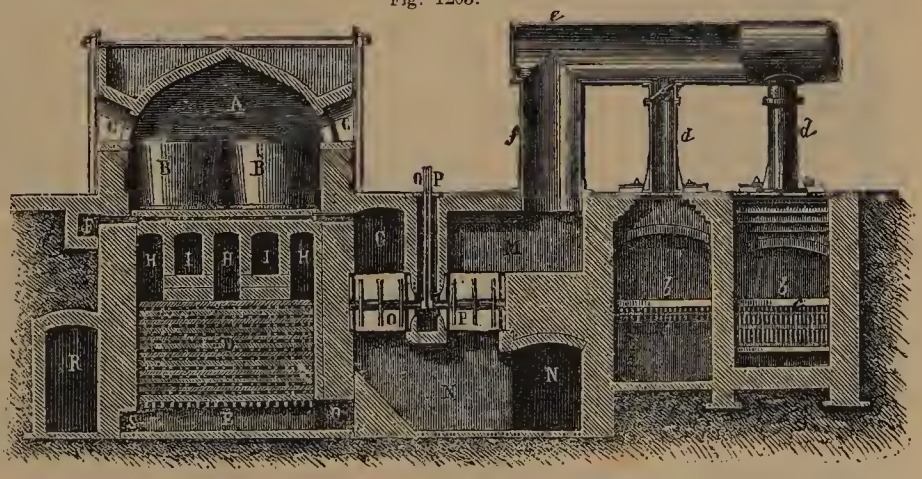
The vaulted roof of the regenerator is the floor of the pot furnace, and is traversed by the longitudinal flues *H I H I*, which communicate on one part by conduit *F* with the open air, and in the other with the flue *G*. Speaking as to any one of the four regenerator chambers, that shown at *D*, for instance, when it is to be *heated* the waste gases from furnace *A* discharge into *H H* and pour downward through the cellular brick structure *D*, through the grated floor into *E*, and thence by *N N* to the chimney; when the regenerator has been sufficiently heated, the valves *O P* are moved and the conditions are changed; the heated gases in *M* coming from the gas producer descend into *E* and pass up through the heated regenerator, to be united with air entering at *G* and passing through a similarly heated regenerator, the two being ignited at their point of junction and filling the furnace *A* with flame.

As one pair of regenerators become heated and the other cooled, the valves which transpose the course of the currents are changed by the motion of a lever, and the functions of the regenerators are changed, and so on alternately.

b b are the grates of the gas-producing furnaces; *d d*, the pipes of ascension for the gases; *e f*, flues communicating with chamber *M*, whence the gases are emitted to one or the other regenerator, as the case may be. See GAS-GENERATING FURNACE.

In the works of Lloyd & Summerfield, Birmingham, England, the application of the Siemens furnace to glass-works was first made, with the result of changing the consumption of fuel from 35 tons of superior coal, to 16 tons of inferior coal, per week.

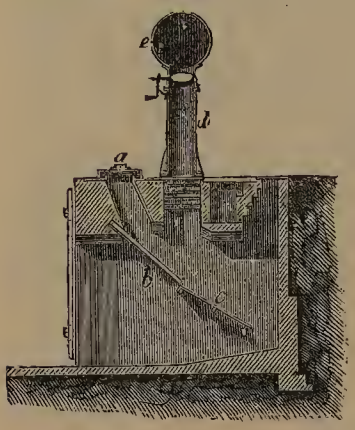
Fig. 1205.



Siemens Furnace as applied to Glass Works.

Fig. 1205 is a vertical section through one furnace in a line at right angles to the view given in Fig. 1206.

Fig. 1206.



Siemens Regenerator. Glass Furnace.

"The Siemens furnaces have been used quite extensively in metallurgy with great success; in this country we find but three glass-houses using them, viz., Burgin & Sons, of Philadelphia, the Lenox Plate Glass Company, and the Crystal City Plate Glass Works. In Europe we find quite a number of firms using them; in England, five plate-glass works, twelve window and bottle houses, and one flint house; in France, seven plate works, ten window and bottle works, and nine flint factories; in Germany, three plate works, eight window and bottle houses, and twelve flint works; in Belgium, four plate works, one window house, and one flint factory. These furnaces have also been introduced in Russia, Portugal, Hungary, and Austria." — *Colné.*

The Boëtius gas furnace, without the regenerating principle, has been introduced among European manufacturers. It is much simpler in construction than the Siemens. The gas generator is somewhat similar to that of Siemens, but the gases, instead of passing through regenerators, are conducted directly to the furnace with a sufficient quantity of air, and there ignited. The air, by passing through passages under the bottom of the furnace, serves to cool the bench, and thereby receives a certain degree of heat extracted from the hot bricks. The furnaces do not cost as much to construct as a regenerating furnace, they are easy of management, and the heat can be readily regulated.

The Ponsard furnace is also used in glass works, and has been described elsewhere. See GAS-GENERATING FURNACE, Figs 1158-1162, pp. 385-387, *infra.*

In it the heat escaping from the fire-chamber, after having done its work, is conducted to a regenerator under the furnace, made somewhat in the same style as the Siemens. Instead, however, of one of the regenerators receiving the gas from the generator and the other the air to be mixed in the furnace, and having four regenerating chambers, the Ponsard system uses but one chamber This regenerating chamber is made up of a number of passages adjoining one another, one series of which receives the hot gases after combustion, and the other receiving the air to be heated by the absorption of heat from the adjoining hot canals. This system is, therefore, continuous, and simpler than the Siemens.

The Siemens compartment furnace is a substitute for the bench with pots, the furnace being a tank divided into three compartments by means of transverse floating bridges. In the first compartment the batch is melted, in the second compartment it is refined, while the third compartment is the receptacle for the thoroughly purified glass, from which it is worked out *continuously.*

"The principal advantages resulting from the use of the continuous melting furnace are: —

"1. An increased power of production, as the full melting heat may be employed without interruption, whilst, with the old method of melting, nearly one half of the time is lost by cooling and settling the metal, the working out of the same, and the re-heating of the furnace.

"2. An economy in working, as only one half the number of men are required for the melting operations.

"3. A greater durability of the tank or furnace, owing to the uniform temperature to which it is subjected.

"4. A much greater regularity of working, and more uniform quality of the product than in other furnaces.

"5. For the manufacture of window glass, the compartment may be so arranged that the blowers can work without interfering with the gatherers: this does away with the separate blowing furnace now in use.

"The reason of the greater durability of the tank is not only due to the uniform temperature maintained, but also to the circumstance that the batch is filled in, in such quantities as not to come into contact with either the sides or the bottom of the tank, which consequently are not suddenly cooled or eaten away by the mixture; also to the fact that each compartment of the tank is subjected only to the requisite amount of heat necessary for the purposes carried on therein.

"The difference in the specific weight of the glass at the different stages of melting is used for keeping the metal separate in the several compartments, and the operation of charging the melting compartment with raw material causes the necessary onward pressure." — *Siemens.*

Atterbury's tank furnace is shown in Fig. 1207. The tank is shaped like an oval dish, and the arch has the same form; in order to expose a large surface of the glass, relatively to the quantity, and secure a favorable reverberatory form to the arch. The division enables different colored glasses to be worked from the heat and furnace.

Duryee's glass furnace is a revolving cylinder with a blow-pipe flame fed with petroleum and steam jet.

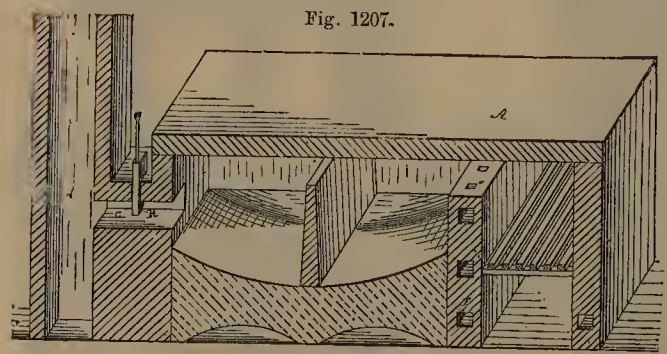
Franke's glass furnace is a revolving cylinder having perforated ends for the entrance of the flame from any desired form of fuel chamber, and for its exit to the chimney at the other end. The jacket is lined throughout with a lining of refractory fire-clay, and has openings on its sides for the purpose of access to the glass, and through which the workmen *gather* the glass for the different articles to be produced; another opening is provided, through which the *batch* of materials of which glass is made is introduced. All these openings are provided with doors lined with clay, and which are bolted shut during the *melt* or period when the melting is being done. The cylinder is mounted on anti-friction rollers, and is rotated on its axis by a rack secured to its outside surface and a pinion driven by steam power. This rotation causes the entire mass to be uniformly exposed to the flame traversing the cylinder, also causes the constant reglazing of the sides and ends of the furnace, and prevents the undesirable action of the *gall*, which has proved so detrimental to stationary tank furnaces.

See also *Colné's "Report on Glass at the Paris Exposition,"* 1878, vol. iii., 352 *et seq.* Also —

Siemens * *"Scientific American Supplement,"* 2176, * 3966.
Greeley * *"Scientific American Supplement,"* 1838.

Crystal glass furnace, French and Belgian, Bohemian, *Laboulaye's "Dictionnaire des Arts,"* etc., cap. *"Verre,"* tome iii., ed. 1877.

Fig. 1207.



Tank Furnace.

Glass, Hardened. See GLASS, TEMPERED.

Glass'ing. (*Leather.*) Smoothing and polishing a side of leather by means of a plate glass slicker or glassing jack.

Glass'ing Jack. (*Leather.*) A machine in which is fitted a plate glass slicker for polishing and smoothing leather.

Glass Mill'stone. Blocks of glass of from 6″ to 12″ wide are cast in a shape similar to the pans of the French buhrs, but more regular and uniform. They are united with cement in the same way, and dressed and furrow-cut with picks, pointed hammers, and diamond-dressing machines.

"Engineering and Mining Journal" . . xxvii. 297.
"Mining and Scientific Press" . . . xxxvi. 387.
"Scientific American Supplement" . . 1940.

Glass Press. The subject of the principles and practice involved in the making of glass objects by pressure in molds is carefully and lucidly treated by M. Colné in his Report on Glass at the Paris Exposition of 1878, vol. iii., pp. 378 *et seq.* The various requirements of special forms and complicated structures are there given *in extenso.*

Glass Ring. (*Microscope.*) A circle of glass

for forming a cell in which a thick object is mounted.

Glass Silk. A product obtained by winding fine threads of glass in fusion on rapidly rotating and heated cylinders.

In the microscope the threads are as fine as those of silk or the fibrillæ of cotton. They break more easily than the latter, but are excessively supple. From the inalterability of the substance, it is very well suited for filtering acid or alkaline solutions, even concentrated, and various other substances, such as nitrate of silver, albumen, collodion, Fehling's liquor, etc. It affords great rapidity of flow, with good filtration. It is preferable to amianthus, which from the arrangement of its parallel fibers cannot be formed into a flexible ball, and which lets fragments pass that float in the liquid. For analysis it is very advantageous, allowing of a ready determination of insoluble matters deposited; also, by calciuation and fusion of the glass may be fouud the volatilc principles fixed in the passage of the liquid, unmixed with empyreumatic products.

Glass is capable of extremely fine filiation either by the winding process, cited above, or by means of a blast, in which latter case it assumes a flocculent quality. See MINERAL WOOL.

Glass Sil'ver-ing. Silvered plate glass is produced hy causing a slight coating of mercury to adhere to the glass. To obtain this result mercury must be retained by a metallic medium; it is, therefore, amalgamated with tin. Mercury has been chosen owing to its power of reflecting light very brightly.

The process has been described on pp. 982, 983, "*Mech. Dict.*" See also pp. 2184, 2185, *Ibid.*

A solution of silver has been largely substituted for the mercury amalgam. The Pettitjean process is as follows: —

"The operation is very similar to silvering with mercury. The table, instead of being a stone, is a hollow sheet iron table, made quite smooth on its upper surface, and containing inside water capable of being heated by means of steam, to bring the temperature to 95°–104°. Preparatory to silvering the glass it should be thoroughly cleaned. The table being ready, a piece of oil-cloth is spread over it, and upon this is laid a piece of cotton cloth. The plates are now put singly upon these cloths, and the following solutions are poured over them: —

"*Liquor* No. 1. Dissolve in a liter of water 100 grams of nitrate of silver: add 62 grams of liquid ammonia of 0.880 density; filter and dilute with 16 times its volume of water. Then pour in this liquor 7.5 grams of tartaric acid dissolved in about 39 grams of water.

"*Liquor* No. 2. This liquor is precisely the same as the other, with the exception that the quantity of tartaric acid is doubled, say 15 grams.

"First pour liquor No. 1 upon the plates, as much as will remain upon the surface without running over. The heat of the table is now increased gradually to 95°–104° Fah., and in about thirty minutes the glass is covered over with a metallic coating. The table is now inclined and the plates washed with water, which carries off the surplus silver. The table is again raised, and liquor No. 2 is now poured over; in about a quarter of an hour another coat is deposited, which covers the glass completely. The plates are again washed; then they are carried to a slightly heated room, where they are gradually dried.

"This operation, as will be seen, is quite simple, and is generally performed by women. The silver carried off in washing and that contained in the cloths is recovered again. Since glass silvered by this process is liable to be altered when exposed to the air, and the coating may become easily detached if not covered over with a protecting coat of paint, the silver pellicle is covered with an alcoholic copal varnish, put on with a brush, and when this is dry a coat of red-lead paint is put on.

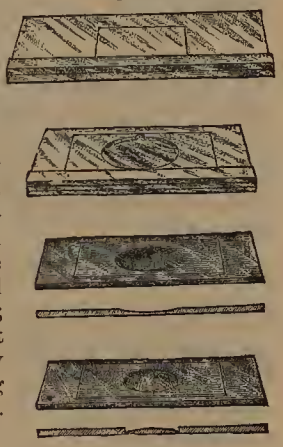
"Plates silvered by this means have more brilliancy than with mercury, but as there is a slight tinge of yellow given to objects reflected by these mirrors, they were at first objected to. This objection has passed away, however, to a great extent, and the yellow reflection has been obviated by giving a slight coloration to the glass. The new silver process costs about 36 cents per square meter. Inasmuch as such works as the St. Gobain have adopted it, and as the terrible disorders caused by mercury may be thus avoided, there should be no hesitation in adopting this new process everywhere." — *Colné.*

Glass Slip. (*Microscope.*) For mounting objects: usually 3′ × 1″ in size, made of crown or plate. See Fig. 1208.

Glass Stage. (*Microscope.*) A platform in the microscope, used instead of brass on account of cleanliness.

Glass, Tem'pered. Siemens' process consists in heating, then suddenly cooling the glass to be hardened and tempered; but when the articles are such as are usually molded, the hardening and tempering are accomplished at the same time as the pressing — that is, the molten glass is run into suitable molds, and while still highly heated, is squeezed; the molds having the effect of giving the necessary cooling without resorting to the liquid bath of M. Bastie.

Fig. 1208.



Glass Slips.

a. Glass slip with ledge.
b. Glass slip with hollow ledge and lip.
c. Glass slip with hollow.
d. Weber's slip with convex cell.

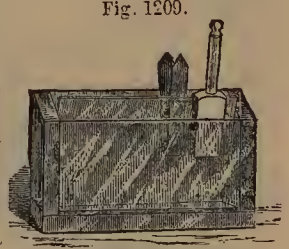
The material employed for these molds depends on the nature and thickness of the glass. In ordinary practice, however, it is found that cast-iron molds maintained at a temperature of about 212° Fah., and earthenware molds kept quite cool, yield very satisfactory results. The liquid glass may be conveyed direct to the molds, or may be taken from the melting furnace on the blower's pipe, and shaped in the mold, but it is preferable to heat the articles after shaping, before pressing and cooling them.

Siemens	"*Van Nostrand's Mag.*," xiv. 572.
	* "*Scientific American*," xxxvi. 18.
	"*Eng. and Mining Jour.*," xxiii. 206.
Paper by *Bourrée* .	"*Engineering*," xxii. 299.
	"*Scientific American Sup.*," 1480.
Comp. of *De la Bastie & Siemens*	"*Scientific American*," xxxvii. 177.
	"*Manufacturer and Builder*," xii. 38.
	"*Scientific American*," xxxviii. 119.
For railway sleepers,	"*Engineering*,"
	"*Eng. and Mining Jour.*," xxviii. 225.
Wood, Br. . . .	* "*Engineering*," xxviii. 272.
	"*Iron Age*," xxiv., Sept. 11, p. 7.

Glass Tile. A roofing plate made of glass pressed in imitation of the clay article. The French glass tiles are molded in such a shape that they can be laid alongside of one another, making tight-fitting joints without cement or mortar; 13 tiles cover a square meter; each tile weighs about 5½ pounds.

Glass Trough. (*Microscope.*) A means for keeping aquatic objects in a film of their natural fluid for observation. A division plate and wedge admit of forcing them to one side of the trough so as to be convenient for observation.

Fig. 1209.



Glass Trough.

Glass Type. Glass cast into type form and toughened by the De la Bastie process. Said to have remarkable wearing quality and to be unaffected by acid, inks, and colors. *Montcarmont & Dumas*, of Paris.

"*Manufacturer & Builder*" . . . . . xii. 145.

Glau-com'e-ter. An instrument for measuring the density of *must*. The degrees of the glaucometer show the density of the (grape) must, deducting 1 in 12 for foreign matter.

Glaze. For earthenware: —

Silicate of soda	100
Powdered quartz	15
Mendon chalk	25

With an addition of borax 10 when it is desired to be more fusible.
Copper for green color.
Manganese for brown. *Constantine.*

Rendle, Br. . . . . "*Engineering.*" xxii. 9.
"*Scientific American,*" xxxv. 353.

Glazed Me'ter. (*Gas.*) One with glazed front and top in order to expose the working of the apparatus; showing the motion of the diaphragm and valves, also the gearing and registering index. Intended for exhibition to persons unacquainted with the working of meters, in order to demonstrate the fairness and correctness of the indications of measurement.

Gla'zing Bar'rel. (*Powder Making.*) A revolving barrel in which powder is glazed with graphite. A barrel holds 400 pounds and makes 40 revolutions per minute, an addition of 0.5 oz. of graphite being made for each 100 lbs of powder. 40 minutes is required for each charge.

See "*Ordnance Report,*" 1879, Appendix I., p. 108.
"*Engineering*" . . . . . * xxv. 138.

Globe. 1. Sphere representing the earth, or the celestial objects.

A skeleton globe with inflated fabric made with gores was shown at the Paris Exposition, 1878. The skeleton is of jointed meridional sections stiffened with zonal rings and revolving on a vertical axis. *Enrico*, Italy.

Artificial, *Browne* . . * "*Scientific Amer. Sup.,*" 101.
Fr. Nat. Library, *Estrées* . * "*Scientific Amer. Sup.,*" 48.
Lyons Museum, A. D. 1708 . "*Sc. American,*" xxxix. 209.
Time, *Jouvet* . . . . . * "*Sc. American,*" xlii. 22.
"*Technologiste,*" xxxiv. 319.

2. A spherical glass for a lamp or burner.

"It is not generally known what a very large proportion of light is obstructed by the glass globes or moons so frequently used over gas flames. From experiments, all made with a light equal to fifteen standard candles, I find the following results: —

	Illuminating Power.	Percentage of Light lost.
Naked flame	15.00	–
Clear glass globe	12.80	14.65
Ground glass globe . . .	11.40	24.00
Opal globe	9.00	40.00
Another opal globe . . .	8.16	45.60
Another opal globe . . .	8.00	46.70
Another opal globe . . .	6.64	55.90
Another opal globe . . .	8.00	46.70
Another opal globe . . .	7.48	50.10

The advantage arising from the use of these moons is that they diffuse and soften the glare of the naked light, which is sometimes oppressive to the eyes. Of the opal globes the dead white semi-opaque one should be avoided. A very good form of globe is that with a wide opening at the bottom, which allows a considerable amount of light to be reflected downwards from the white surface of the inside of the globe." — *Pattison.*

Gas-globe holder, *Lovett*, Br. . * "*Engineer,*" xlv. 419.
Globes. Effect of on gas-light . "*Sc. American,*" xl. 160.

Globe Oil Cup. A lubricator attached to a piece of machinery and having a globular oil chamber. See Fig. 3011, p. 1361, "*Mech. Dict.*"

Globe Sight. (*Rifle.*) *a.* A circular sight; when spherical and upon the muzzle, also called a *bead* sight, or *pin-ball* sight.

b. When *open*, it is also called an *open bead* sight. See Bead Sight, *supra.* The illustrations in Fig. 1210 are open globe sights of various constructions.

Globe Valve. One, the chamber of which is spherical. Such may have a poppet or ball valve and may be for steam, water, gas, air, or other liquid or fluid. The name concerns the shape.

Fig. 1210.

Globe Sights.

A *globe cross valve* is one at the rectangular intersection of two pipes.

A *globe safety valve* is one with a spherical chamber.

And so on, of a globe back-pressure valve, globe check-valve, etc.

A screwed glove valve is one whose valve is worked by a screw; a flanged globe valve one whose connections are by *flange joints* and not by *bell joints.*

Jenkins' globe valve, shown in Fig. 1211, has a valve with an annular packing which is forced down upon the circular seat by the screw. Screw, cap, and valve are removable without disturbing the pipe.

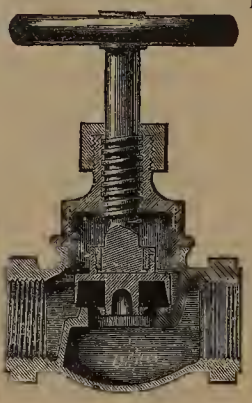
See also Globe Valve, Fig. 2256, p. 988, "*Mech. Dict.*"

Frink's globe valve is shown in Fig. 1212. *A* represents the shell. *B* and *C*, the valve stem and screw. *D*, the valve seat. *E*, the elastic packing of the disk. *F* is a clamping plate, which holds the packing in. *G* is a nut, which holds clamping plate to end of stem. *H* is the disk.

Glos'sing Iron. See Fluting Iron.

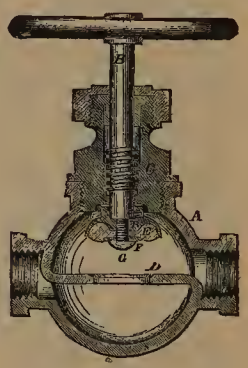
Glove Ma'king. The glove sewing machine of H. P. Hendrickson, Copenhagen, Denmark, shown

Fig. 1211.



Globe Valve.

Fig. 1212.



Globe Valve.

at the Centennial Exhibition, has a tubular arm inclined somewhat from a perpendicular, and about ⅜″ in diameter, and at its upper end a cylindrical shuttle 5–16″ in diameter and ⅝″ long. The shuttle is driven from a pin at the upper end of a rotary reciprocating shaft, twisted at its shank and embraced by a yoke, the reciprocations of which operate the rod after the manner of the looper-rod in the Grover & Baker machine. A flat cloth-support is placed about the upper end of this post, for use in flat work. The needle-bar, operated by a heart-cam and crank, is placed at an angle of from 30° to 40° from a perpendicular. The presser-foot, serrated at bottom, has four motions imparted to it, thereby converting the presser into a four-motioned top-feed.

The glove sewing machine of F. Sandoz, of Paris, was shown at the French Exposition of 1878.

At the Philadelphia Exhibition was also shown the glove and mitten cutting blocks and presses of Newton & Titus, of Gloversville, N. Y.

Glove making . . . . . * "*Sc. American,*" xxxvii. 104.
Glove working, *Townsend* . * "*Sc. American,*" xxxix. 98.
Glove, Decorticating, *Sabate* * "*Sc. American,*" xxxvi. 182.

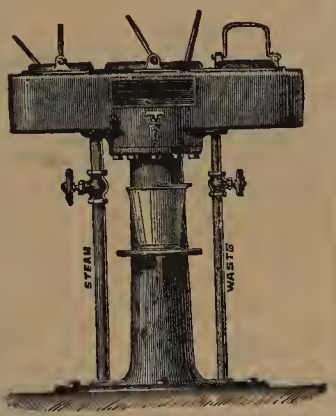
Glue. Refer to: —

Glue making . . . . "*Iron Age,*" xxi., Jan. 24, p. 19.

Glue making . . . . . "*Scientific Amer*," xxxviii. 168.
Glue-heater.
Richardson, Eng. . . * "*Scientific Amer.*," xxxvii. 38.
Glue pot, *Comins* . . * "*Scientific Amer.*," xxxvii. 168.
To prevent glue cracking "*Scientific Amer.*," xxxiv. 353.
Liquid glue . . . . . "*Scientific Amer.*," xxxiv. 352.

Glue Heat'er. A glue boiler.

Fig. 1213.



Glue Heater.

In the figure, the walls of the steam chamber are double throughout, so that the pots do not come in contact with the steam or water. The steam chamber is also cast in one piece, preventing leakage of steam or water, there being but one joint, and that a plain flange which can be made perfectly tight.

The glue pots, three in number, rest on turned flanges which are air-tight, to prevent the escape of heat. The center pot holds one gallon, and the two at the ends one-third gallon each.

Each heater is provided with a water pot, also with steam and waste-cocks, so attached by nipples to the steam chamber, that the connecting pipes may pass down through the base, as shown in the engraving, or in any direction from the heater. — *Richards.*

Glue Wa'ter Core. A dry-sand core in which common glue dissolved in water has been used for giving adhesiveness and strength to the core when dried. For this core a sand containing no loam at all may be used.

Glu'ten Test'er. See ALEUROMETER.

Glu'tine. A preparation by Dr. Bering for stiffening and rendering glossy, calicoes, wall paper, etc.

Freshly precipitated caseine is well washed, dried at 212°, and reduced to a moderately fine powder. This is levigated with a 50 per cent. solution of sodium tungstate. The mass becomes very thick as soon as the solution is added. It is now placed in a boiler and fully liquefied by heat. If it be too dry, a sufficient quantity of water is added. When it has acquired a completely homogeneous consistence, a little carbolic acid or salicylic acid is added to prevent its putrefaction. On cooling, the mass becomes nearly solid.

This preparation, when not completely hardened, is very soluble in water and very adhesive. It also adheres on metal, and may, therefore, be used for labeling tin cans, also bottles and jars. When entirely dry it resists for some time the action of water, but is soluble in glycerine. A mucilage formed by a solution of glutine in water and a small proportion of glycerine forms an excellent flexible varnish for wall paper.

Dissolved in glycerine alone a tough clear mass is formed, which, spread on paper and passed through a solution of alum, acquires the firmness of good batter.

On account of the large quantity of wolframic acid contained in it, it may receive all different tints and colors by the addition of the decoctions of various dyewoods. If, for instance, cotton or linen, soaked in a solution of glutine and dried, is passed through a decoction of logwood, it is dyed violet.

By soaking cottons or linens in glutine solutions, drying, and passing them through solutions of the mineral acids or salts of the same, they are dyed in various colors, resisting the action of soap and water and even that of alkalies. — *Chemiker Zeitung.*

Glyc'er-ine Ce-ment'. For metals and packing joints: glycerine and litharge; made of any consistence to suit. It withstands a temperature of 275° C. Is useful for galvano-plastic purposes, as it reproduces a surface with delicacy and accuracy.

Glycerine . . . . "*Scientific American*," xxxv. 249.
Uses of (solutions, etc.) "*Scientific American*," xxxvi. 69.
Uses of glycerine . . "*Scientific American Sup.*," 1813.
Cement . . . . "*Scientific American Sup.*," 2597.

Gnaw'ing For'ceps. (*Surgical.*) Forceps used in osteotomy for biting away portions of necrosed bone, or removing sharp projecting portions. *Ronguer.*

Gold.

Leaf-making . . . . "*Scientific American Sup.*," 4023.
"*Iron Age*," xviii., Sep. 28, p. 6.
Process, *Plattner*, Cal. . * "*Engineering*," xxiv. 119.
Transparent . . . . . "*Scientific Amer.*," xxxvi. 385.
Volatilized . . . . "*Scientific Amer.*," xxxv. 154.
Washing at Yesso, Japan "*Scientific American Sup.*," 222.

Gold Al-loy'. An alloy resembling gold. Sometimes the composition has the color and specific gravity of the genuine metal.

Meiffren's. — 800 parts of copper, 28 of platinum, and 20 of tungstic acid are melted in a crucible under a flux, and the melted mass poured out into alkaline water, so as to granulate it. It is then melted together with 170 parts of gold. It resembles 750-1000 fine.

Another. — Pure copper, 100 parts; zinc, or preferably tin, 17 parts; magnesia, 6 parts; sal-ammoniac, 3.6 parts; quicklime, 1.8 parts; tartar of commerce, 9 parts, are mixed as follows: The copper is first melted, then magnesia, sal-ammoniac, lime and tartar are added separately and by degrees, in form of powder. The whole is next briskly stirred for about half an hour so as to mix thoroughly, after which the zinc is added in small grains by throwing it on the surface and stirring it till it is entirely fused; on this being done, the crucible is then covered and the fusion maintained for about 35 minutes, after which the surface is skimmed and the alloy is ready for casting. This alloy has a fine grain, is malleable, and takes a splendid polish. It does not corrode readily. *Schmitte's.*

Another:	Copper	8
	Tin, $1\frac{1}{8}$	1
	Zinc, $\frac{1}{2}$	
	Lead, 5-16	

Gold Lacq'uer. An imitation of the celebrated Chinese gold lacquer may be prepared by melting two parts of shellac and one of copal, so as to form a perfectly fluid mixture, and then adding two parts of hot boiled oil. The vessel is then removed from the fire, and ten parts of oil of turpentine gradually added. To improve the color an addition is made of a solution in turpentine of gum gamboge for yellow, and gum dragon for red. These are to be mixed in sufficient quantity to give the desired shade. The Chinese apparently use tinfoil to form a ground upon which lacquer varnish is laid.

Gold Pow'der. Put into an earthenware mortar some gold leaf, with a little honey or thick gum-water, and grind the mixture till the gold is reduced to extremely minute particles; when this is done, a little warm water will wash out the honey or gum, leaving the gold behind in powder.

Gon-do'la Car. (*Railway.*) A car with a platform body, having low side-boards secured by stanchions; or, more seldom, hinged.

Fig. 1214.

Four-wheeled Gondola Car.

Pennsylvania Railway . . * "*Engineering*," xxvi. 430, 439.

Gong. Champion and Yapp have given precise accounts of the Chinese mode of manufacture.

Manufacture of, *Yapp* . "*Van Nostr. Mag.*," xvii 206.
"*Scientific Amer. Sup.*," 1349.
"*Iron Age*," xx., Aug. 23, p. 7

Go'ni-om'e-ter. An instrument fitted to the eye-piece of the microscope; used for determining by means of a double-image prism the angles of crystals.

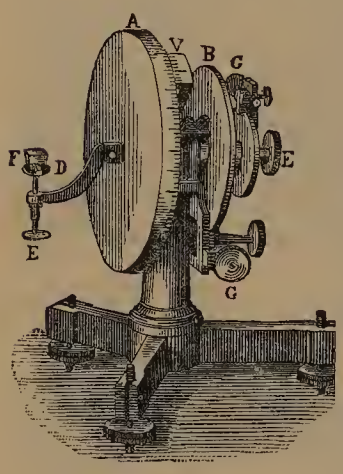
Fig. 1215.

Leeson's Goniometer.

The goniometer of M. Pisani, for measuring the dihedral angles of crystals, is shown in Fig. 1216.

It consists of a circle *A*, divided into degrees and half degrees, and having a vernier, *V*, marked to minutes. The circle is turned by the disk *B*. A second disk moves the axis carrying the piece *D* independently of the circle. This piece is movable normally to the plane of the circle, and supports the platform on which the crystal is placed. *G* and *G'* are adjusting screws for the parts already mentioned.

Fig. 1216.



Pisani's Goniometer.

In order to measure an angle the crystal is secured by wax on the platform in such a position that the ridge of the dihedral angle passes through the axis of the crystal. This position is approximately obtained by movements of the stem *F E*. The goniometer is then placed on a table at some 15′ distant from a candle fixed to the wall. After having determined by the plumb line the foot of the perpendicular passing through the luminous point, two points of view are obtained which are in the same vertical plane. The plane of the circle is then adjusted to the plane of these points. By turning the disk *C* the observer rotates the crystal until he notes on one face the reflected image of the flame. Then continuing to move the crystal he notes whether this reflected image coincides with the lower point of sight regarded directly. If this coincidence does not occur, if the luminous point appears to the left or right of the point at the lower end of the plumb line, it is made to coincide by the screw *E*. The coincidence being thus obtained for one face, the other face is adjusted, and when the two images on each face respectively coincide it remains only to measure the angle.

The circle is placed at zero, and by means of disk *C* the circle is turned until the coincidence of the two points of sight is obtained on the face on the same side as the observer. The eye is kept fixed, and the circle is turned by the large disk *B* until coincidence is obtained with the second face. The angle through which the circle is turned is the supplement of the dihedral angle, and it remains only to substract the measurement now from 180° to obtain the required result. See also Fig. 2267, p. 996, "*Mech. Dict.*"

* "*Manufacturer and Builder*" . . . . . ix 109.
* "*Scientific American Supplement*" . . . . 477, 704.

Goose'neck. A bent pipe coupling, having a joint at one end so as to be revolvable. Used on fire-engines and sprinkler pumps especially.

Gor'get. (*Surgical.*) A cutting instrument operating by a thrust, and used in making the incision in the prostate gland in lithotomy.

Bush's, Fig. 149 *f*.
Dowell's, Fig. 149.
Hooked gorget, Fig. 152.
Blunt gorget, Fig. 139.
Part III., *Tiemann's* "*Armamentarium Chirurgicum*."

Gor'ing Cloth. (*Nautical.*) That part of the skirts of a sail cut on the bias, where the sail widens towards the clews.

Gorse Cut'ter. An instrument of the nature of a chaff cutter, but heavier, used in Europe to mash and chop the gorse or furze (*Ulex Europeus*), which is so common on the uplands and moors. It is a substitute for hay, and a good green food in winter.

Masticator, *McKenzie*, Br. . * "*Engineering*," xxviii. 446.
Mill, *McKenzie & McBude*, Br. * "*Engineer*," xlix. 109.

Gouge. 1. (*Surgical.*) A curve-edge chisel, used in removing portions of bone by a thrust movement, or by blows of a mallet.

Figs. 84, 85, Part I., 90, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

2. (*Dentistry.*) A tool for excavating carious teeth.

Goug'ing For'ceps. (*Surgical.*) A bone-gnawing forceps. *Rongeur.*

The beaks of the forceps have a gouge shape.

Gov'er-nor. A device to regulate the speed of an engine or machine.

Steam Engine Governor, p. 997, *et seq.* "*Mech. Dict.*"

Gas. See GAS GOVERNOR, *supra.*

Water-wheel. Fig. 7126, p. 2646, "*Mech. Dict.*"

The *Condé* automatic safety stop-governor is shown in Fig. 1217, Plate XVIII. The valve has a number of ports giving a large sum of opening with a small motion of the valve.

The steam chamber *A* is fitted with a valve, *B*, composed of rings, stayed together by vertical ribs cast on its inside. The spaces between these rings form ports, through which the steam passes from corresponding ports made in the chamber. The valve is *double-acting*, governing on the downward stroke, and cutting off entirely on the upper stroke when the balls drop to their lowest point.

A sleeve and hand-wheel, *C*, are fitted to the upper part of the frame *D* by a screw connection. This sleeve supports the head *G*, which passes down through it to the driving gear, and is raised or lowered through the screw, thus changing the position of the valve in the chamber, increasing or diminishing the speed of the engine at will. Within the head *G* is fitted the cam gearing for transmitting the motion of the balls to the valve. This gearing increases the travel of the valve in proportion as the balls approach a horizontal line.

H is a throttle, with angular connection for attaching steam pipe without elbows. The valve and seat are of brass, and are removable. The valve rod has its traversing screw outside from the packing box, and passes through the outer end of the gland, which acts as the nut. This arrangement prevents steam acting on the thread, and allows a refitting of the valve in its place, simply by removing the gland.

The valve seat is set into the throttle with a taper joint, so as to be removed for repairs, without taking the throttle apart from the steam pipe.

The *Judson* governor is shown in Fig. 1218, Plate XVIII. The illustration shows the governor, governor valve, and stop-valve combined; the speeder for altering speeds, Sawyer's lever and automatic stop-motion.

In the *Tremper* variable cut-off and governor, shown in Figs. 1219, 1220, 1221, Plate XVIII., the governor is employed not to open and close a valve directly, but merely to determine the point of time at which the cut-off valve shall be closed. This duty requires but little effort on the part of the governor, and its action can therefore be made very sensitive. The cut-off valve is moved by direct attachment to the engine, and is opened and closed at each half-stroke. The time of its opening is fixed and invariable, but its closing is determined by the governor, and varies with the duty to be performed. When the proper amount has passed the valve, the flow of steam into the cylinder is abruptly cut off by the sudden dropping and closing of the cut-off valve, and the volume admitted expands in the cylinder as the piston recedes, the pressure constantly diminishing until the exhaust port is opened and steam released.

Figs. 1219, 1221 are respectively perspective and sectional views of the cut-off governor, and Fig. 1220 is an enlarged view of some of the important parts. In this illustration *G* is the lower end of the governor ball stem, fastened to the wedge *W*; *L L* are the lifters; *C*, the bell crank; *H*, the cork holder; *R*, the ring of rubber or cork, upon which the beater *B* falls, after the steel plates *P* of the lifters are disengaged from those of the beater, by the wedge *W*; *V* is the valve stem, to the upper end of which the beater is attached, and to the lower end the cut-off valve. The movement of the beater is, therefore, identical with that of the valve. The rock-rod imparts a rocking movement to the bell-crank which moves the lifters upward and downward alternately, a given distance. The hardened steel plates, fitted into the lifters, project so far as to engage with corresponding plates in the beater. When the cone is raised by the governor balls to its full height, one of the lifters will carry the beater

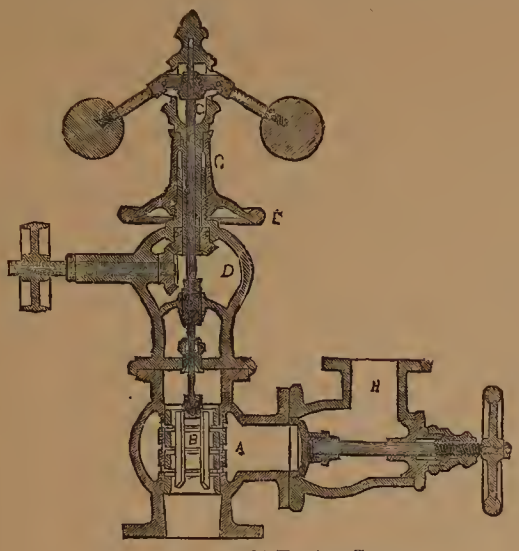


FIG. 1217. *Condé Engine Governor.*

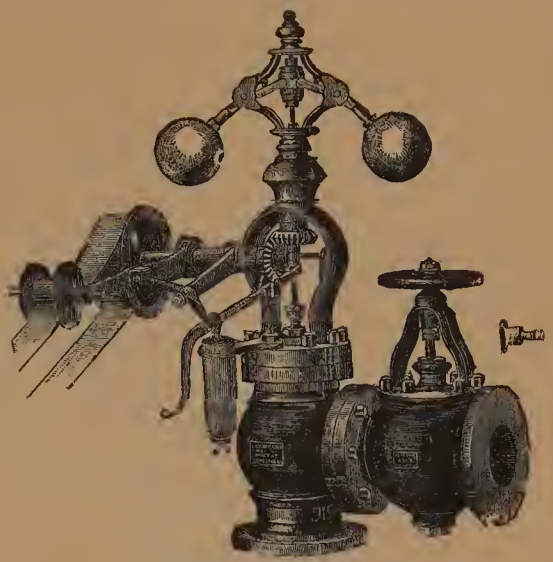


FIG. 1218. *Judson Governor*

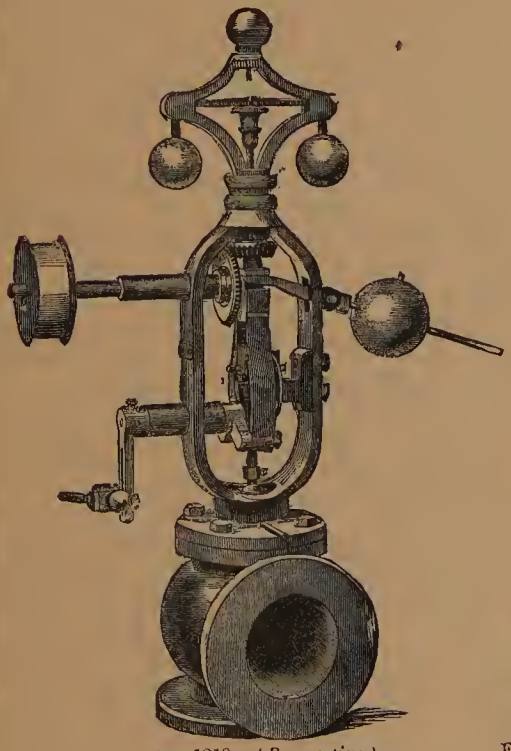


FIG. 1219. (*Perspective.*)

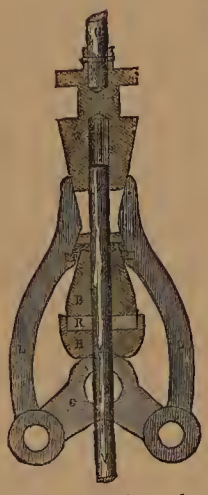


FIG. 1220. (*Portion enlarged.*)
Tremper Variable-Cut-off Governor.

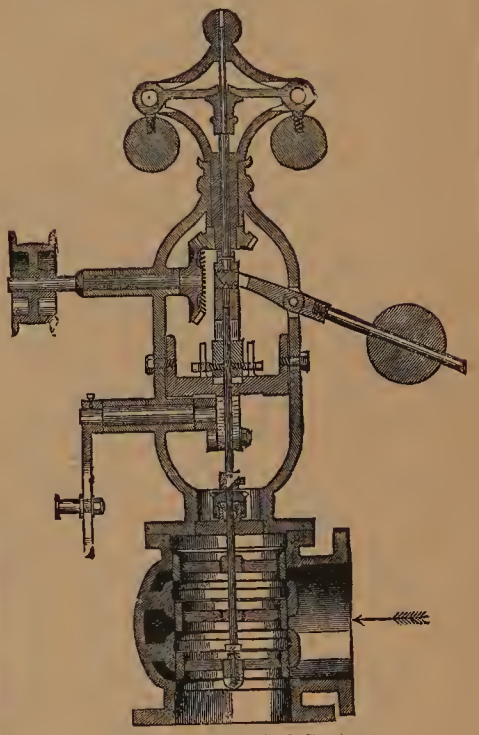


FIG. 1221. (*Vertical Section.*)

FIG. 1222. *Waters Governor.*

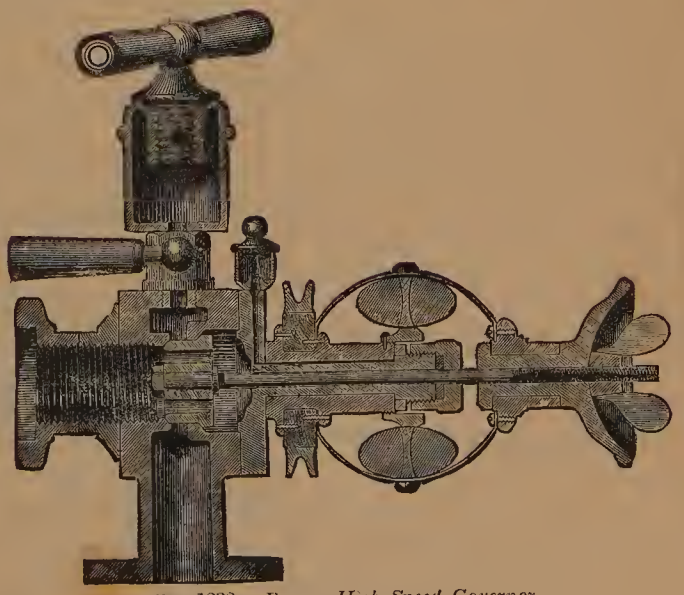
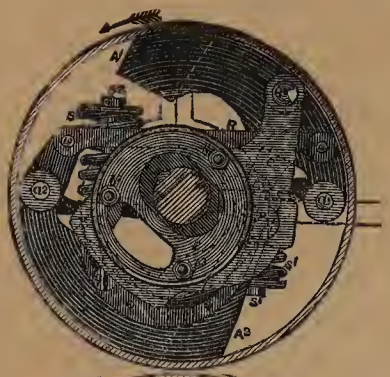


FIG. 1223. *Bourne High Speed Governor.*



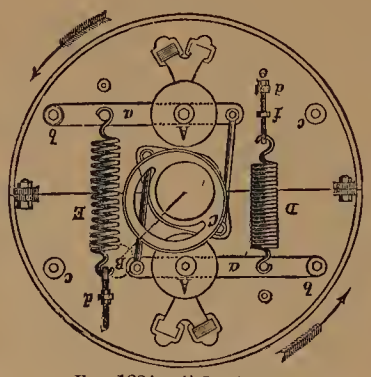


FIG. 1224. "*Buckeye*" *Engine Governor.*

FIG. 1228. *Allen Governor.* (*Vertical Section.*)

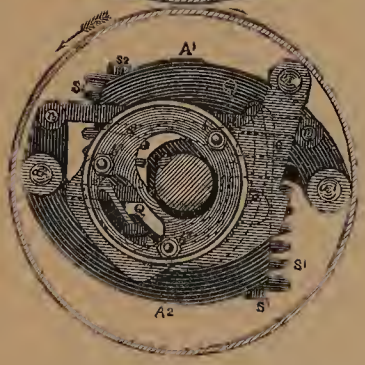


FIG. 1225. *Hartnell's Engine Governor.*

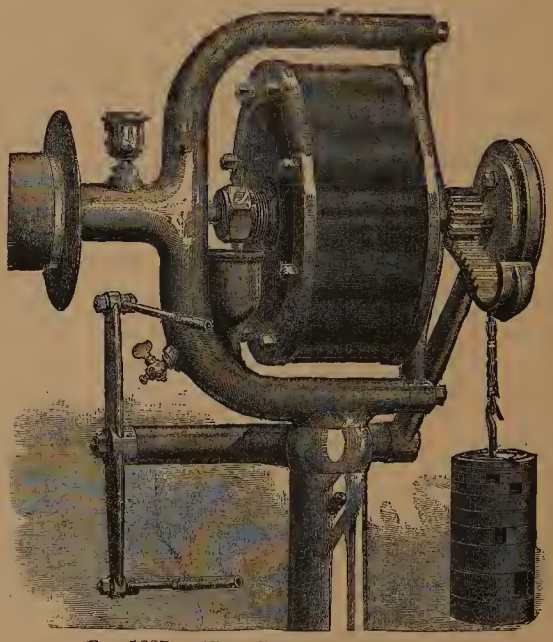


FIG. 1227. *Allen Governor.* (*Perspective.*)

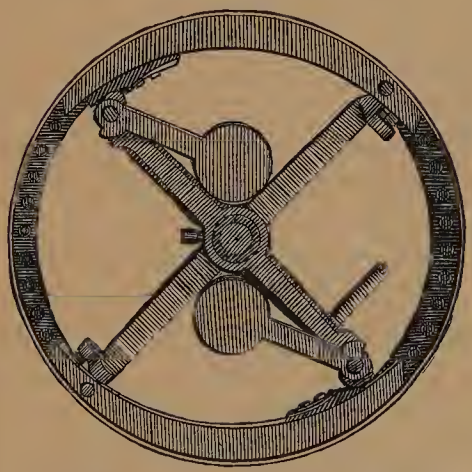


FIG. 1230. *Heebner's Horse-power Governor.*

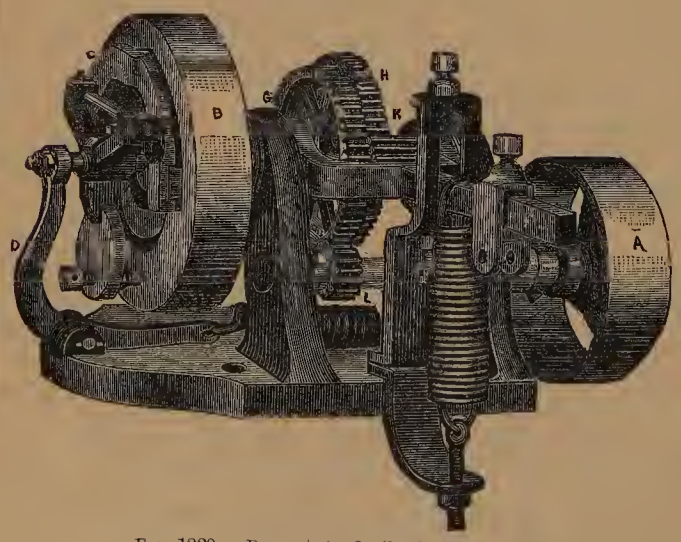


FIG. 1229. *Runqvist's Oscillating Governor.*

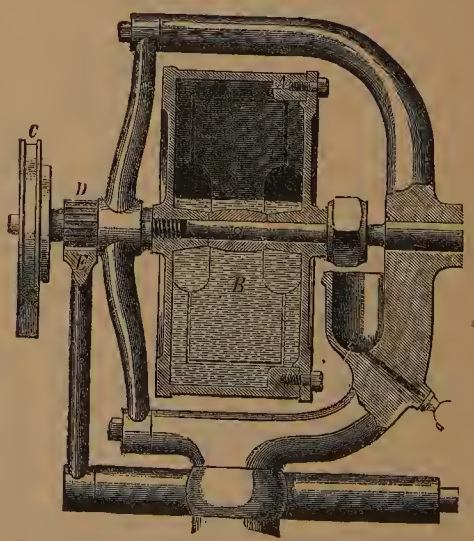


FIG. 1226. *Allen Governor.* (*Vertical Section.*)

upward, opening the cut-off valve; and as the steel plates are not, under these circumstances, disengaged by the wedges, but remain in coutact, the valve remains open until it is closed by the lifter in its downward movement. It is then reopened by the lifter on the opposite side, which represents the return-stroke of the piston. When this condition exists, the engine is said to be "*carrying full stroke.*" The steam is not being cut off, but is freely admitted to both ends of the cylinder, and the full power of the engine is being developed. If a less amount of steam is sufficient to maintain the speed of the engine, the wedge *W* is moved downward by the operation of the governor balls and the lifter, sliding outward as it moves upward, is disengaged from the beater, and the valve is allowed to drop instantly into its seat, cutting off the passage of the steam into the cylinder.

The duty of the governor, therefore, is only to determine the position of the wedge *W*, the power required to move the valve being derived directly from the engine itself, operating through the lifter.

The engine governor of *Waters* is shown in Fig. 1222, Plate XVIII. The action of springs is supplemented to that of balls.

The balls are attached to the ends of curved springs, and supported from the ends of bell-crank arms which are pivoted to the revolving sleeve of the governor. In the axis of the sleeve is the upward extension of the valve-stem, and tappets on the inner part of the bell-crank work in the groove of a collar on the valve-stem, so that when the balls fly out by access of speed the tappets force down the stem, and so operate the throttle-valve in the chamber. One end of each of the springs is bolted to the sleeve and the other end connected to a suspended ball, the whole arrangement of balls, springs, and sleeve revolving around the stem. The end of the valve-stem is extended through the top of the composition collar and furnished with a handle with which to turn it and a check-nut to hold it in place. Screwing this stem down causes the engine to run slower, screwing it up causes it to run faster.

Fig. 1223, Plate XVIII., shows the *Bourne* high-speed governor (Br.). The whole is made of polished brass. The spindle carries two bent springs, at the center of which two brass weights are situated, and the spindle, springs, and weights are rotated by a small pulley driven by a cord from the shaft The spindle carries a double-beat valve which is closed or opened by the centrifugal action of the weights or the centripetal action of the springs. The latter is a constant quantity, but is overcome more or less by the centrifugal force as the speed of the engine varies, thus regulating the admission of the steam. The double-beat valve acts also as a stop-valve, its position being governed by the hand-wheel at the end of the spindle, while the periphery screw prevents this wheel from moving from the position at which it is set. On the top of the governor there is a grease cup, by which oil or grease is continuously fed in with the steam. The thumb-screw at the end serves to regulate the speed of the engine, or to stop and start the latter. The governor takes up but little room, and is an improvement on the somewhat similar arrangement long used by Mr. Bourne

The variable cut-off governor of the "Buckeye" engine is shown at Fig. 1224, Plate XIX.

The cut-off mechanism consists of a light cut-off valve, working on the inner face of the main valve, the stem passing out through the hollow steel stem of the main valve, and being driven from a loose eccentric on the shaft with a special motion derived from the compound rock shaft. This loose eccentric is controlled by the governor, Fig. 1224, which is a shell fast upon the shaft and revolving with it. In this shell are pivoted two weighted levers, the outer ends of which are linked to the flange on the elongated sleeve of the loose eccentric. The centrifugal force developed in the weights throws them outward, and two steel coil springs furnish the centripetal force. The system being coupled is independent of gravity, and the speed determines the position of the weighted arms, which, in turn, determine the angular advance of the eccentric and the consequent point of cut-off, the range of which is from zero to nearly three quarters of the stroke.

Fig. 1225 shows a *Hartnell's* governor (Br.), in which an arrangement similar to that shown in Fig. 1224 is adopted. The entire governor is carried by a disk keyed to the crank shaft. The purpose is to regulate the admission of steam to the engine cylinder without in any way throttling it, altering the stroke of the eccentric without altering the lead of the slide valve

The figures show the weights extended and collapsed, respectively

A^1 and A^2 are the weights, a^1, a^2, the pins on which they swing *R* the link connecting the weights with each other at r^1 and r^2 *E* is the eccentric, having a slotted eye, through which the crank shaft passes; it is fastened to the carrier, *C*, by the bolts b^1, b^2, b^3, and swings from the center e^1. *Q* is the quadrant fastened by the screw *q* to the weight A^2, the arm of this quadrant slides through a swivel pivot *P*, on the eccentric carrier *C*. S^1, S^2, are the springs which control the expansion of the weights, s^1, s^2, the adjusting screws for the springs.

On the engine being put in motion the centrifugal force tends to drive the weights, A^1, A^2, outwards, but they are prevented from flying out too readily by the restraining force of the spiral springs, S^1, S^2. The quadrant *Q* is so fixed upon the weight A^2 as to form an angle inclined to its path of motion, by sliding through the swiveled pivot *P*, and acts as an incline to shift the eccentric, which it does in correspondence with the movement it derives from the governor weights as they fly out or come in, giving more or less eccentricity to the eccentric, and consequently more or less stroke to the slide valve, and steam to the cylinder.

The construction of the *Allen* governor, Figs. 1226–1228, Plate XIX., is as follows: —

Within a corrugated cylinder, which has small projecting ribs on its interior periphery, and which is partially filled with oil, a paddle-wheel is caused to revolve by a spindle passing through one end of the cylinder, driven by a belt communicating with the fly-wheel shaft. The tendency of the revolving paddle-wheel is to cause the cylinder to move in the same direction. On the opposite side to the revolving spindle is a trunnion or short spindle fixed to the cylinder, attached to which is a wheel carrying a set of movable weights suspended by a chain, the speed of the engine being regulated by the number of weights. Attached to the wheel and keyed on the end of the short spindle is a pinion revolving with the cylinder, and working in a toothed sector, the arm of which, being fixed on the spindle of the throttle-valve, opens or closes it as the oil cylinder moves with the paddle, according to the variation of load thrown on the engine. When used with variable cut-off engine, the arm is attached direct to the cut-off.

Fig. 1229 shows the engine governor by *Rungvist*, of Sweden. Its principle is to develop a pressure produced by frictional resistance depending upon the velocity.

To the rapidly revolving main spindle of the governor is rigidly attached a bracket which carries on one side a set screw, and on the other a segment of an iron ring, *C*, in which are mounted three blocks of hard wood. This segment is so attached to the bracket that the faces of the three wooden blocks can readily adjust themselves to form one plane with the point of the set screw, however the latter may be adjusted. This plane is not at right angles to the revolving spindle, but is more or less inclined

A heavy ring, *B*, is so attached to the body of the governor by a universal joint that it cannot revolve, but can freely oscillate. This ring is adjusted closely against the wood-blocks and set-screw mentioned before; and the latter forming a plane inclined to the spindle, rotation must transmit an oscillating movement to the ring *B*. This oscillation brings into play the inertia of the mass of the ring, reacting against the wood blocks, and producing, by friction, a resistance against the rotation of the shaft, evidently increasing with the speed.

The governor is driven from the engine by the pulley *A*, whence the motion is transmitted by the pinion *L* to the wheel *G*, which revolves loose on the main spindle of the governor. This wheel gears into a pinion fastened to a spindle, to which the wheel *H* is keyed; and this wheel finally transmits the motion to the main spindle by the pinion *K*. The lever *F* is forked at its fulcrum, that is formed by the main spindle, and it is extended beyond this fulcrum, carrying the spindle of the wheel *H*. From this it will be seen that the combination of wheels forms a differential gear; and here is where the resistance offered against the rotation of the main spindle meets its opponent — the tension of a vertical spiral spring — that will be elongated more or less according to the speed. The lever *F* carries on its front end an adjustable saddle, to which the valve rod can be attached.

Fig. 1230 is Heebner's speed regulator, for railway horse-powers.

The rim or circle is fastened to the power behind the belt wheel, and leaves the shaft exactly in the center. The hub with its attached arms, weighted balls, and friction blocks, has a stud with small coiled brass spring secured by a thumb-screw at the end to regulate the amount of speed. As the speed increases the balls are thrown out by centrifugal force, and press the friction blocks against the rim, thus acting as a brake; but as soon as machinery is applied, and takes the power, the balls fall back and relieve the braking

2. (*Gas.*) *a.* An instrument or apparatus to regulate the flow of gas. See Gas Governor; Gas Regulator.

b. An attachment to a gas exhauster which causes the pressure in the main to determine the speed of the engine running the exhauster. See Gas Exhauster Governor.

Refer to: *Allen* . . . . * "*Iron Age*," xvii., June 15, p. 1.
* "*Polytechnic Review*," ii. 82.
* "*Min. & Sc. Pr.*," xxxviii. 81.
* "*Manuf. & Builder*," xii. 129.

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	* "*Am. Manuf.*," Aug. 13, 1880, p. 13.
Audrade, Fr.	* "*Engineering*," xxiv. 443.
	* "*Sc. American Sup.*," 1824.
Throttle, *Bagnall*, Br.	* "*Engineering*," xxviii. 5.
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Chase	* "*Sc. American*," xxxix. 35.
"Buckeye engine"	* "*Sc. American*," xxxviii. 310.
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	* "*Engineer*," xliv. 395.
Cosine, *Buss*, Ger.	* "*Engineer*," xliii. 58.
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	* "*American Miller*," vii. 65.
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	* "*Engineer*," xlvi. 190.
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Porter	* "*Thurston's Vienna Report*," ii. 32-34.
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Rigby	* "*Min. & Sc. Pr.*," xxxvi. 385.
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Equilibrium, *Shanks*, Br.	* "*Engineering*," xxviii. 28.
Tabor	* "*Sc. American*," xxxvii. 150.
Tracy	* "*Engineer*," xlviii. 431.
True	* "*Sc. American*," xxxv. 354.
Varying speed, *Wallis & Steevens*, Br.	* "*Engineering*," xxix. 322.
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	* "*Engineer*," xlvi. 248.
Ring, *Wile*, Br.	* "*Engineer*," xlvi. 423.

See also MARINE GOVERNOR; TACHOMETER.

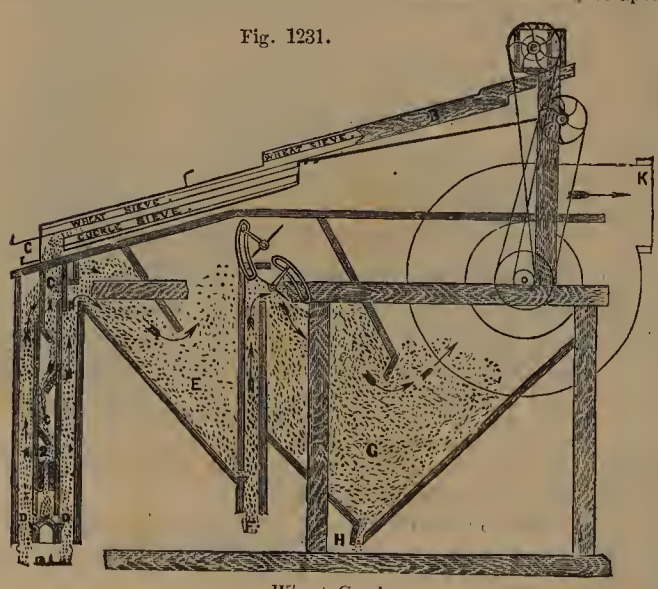
Gra'der. 1. (*Railway.*) A temporary track is laid, and from a platform and caboose car on this track a double plow is rigged out to throw up a track. — *Harden.*

2. An earth scraper.

3. (*Milling.*) A machine for separating grain into lots of varying qualities. Barnard & Lea's wheat grader acts by the combination of sieves and suction blast.

The wheat is received on a broad inclined sieve, *B*, and thence to a second or cockle sieve, and passes to the separating trunk *C*, where it meets the up-blast of air which enters at *D'*. The force of the blast is regulated to perform the separation required; the heavier grain falls at *D'*, second-grade grain is carried up and deposited in *E*, whence it reaches a second separating trunk *F* with up-blast of air, and parts with the screenings, which falls into *G* while the dust goes to the fan and is blown out. See also GRAIN SEPARATOR.

Fig. 1231.

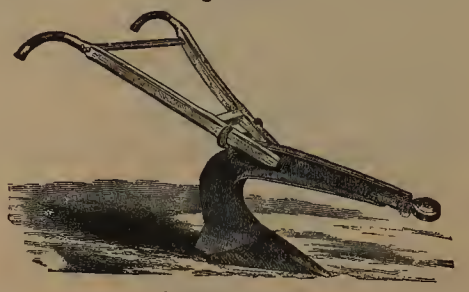


Wheat Grader

Gra'di-ent'or. A form of surveyor's compass especially adapted for leveling and grading.

Gra'ding Plow. A heavy and strong plow used in road-making and road-working; plowing up the neighboring sod or soil to be removed by the scraper.

Fig. 1232.



Grading Plow.

Gra'ding Scra'per. An earth scraper. See SCRAPER.

Grad'u-a'ted Spring. (*Railway.*) A round-bar single-coil spiral-spring, with two conical india-rubber springs on the inside, one attached to the spring-seat and the other to the spring cap. When the spiral spring is extended, there is some space between the two rubber springs. The weight is first supported by the spiral spring until this is compressed far enough to bring the two rubber springs in contact, when they support part of the load. — *Forney.*

Grad'u-a'ting Sight. (*Fire-arms.*) One graduated for distance, wind, etc. See VERNIER SCALE SIGHT, for the former; WIND GAGE SIGHT, for the latter.

Graf'i-to. (*Fine Arts.*). Italian *Sgraffito.* A style of picture in which a thin light ground is cut, chipped, or scraped away to expose a dark under surface. See Fig. 1233.

It is principally used in artistic ceramics, *pateræ*, etc. See Prof. Blake's Report, "Paris Exposition Reports," 1878, vol. iii., for numerous examples, in which the designs are incised in a thin layer or covering of white slip over a dark red-colored coarse clay body.

In grafito, the figure is outlined by a sharp steel point, and then for the background and shadows the slip covering scraped away to give various depths of color. The design is thus left upon the surface in flat relief, being a mere film not much thicker than a card. The whole surface is then enameled with a fusible hard glaze which incorporates itself with the body and slip, and gives a mellow softness and finish to the work.

Graft'er. A fine-toothed, pointed, narrow-bladed hand-saw, used in sawing off limbs and stocks for the insertion of grafts.

Grafting tool . . . * "*Scientific American*," xl. 212.

Graft'ing Scis'sors. (*Surgical.*) A skin grafting scissors, for cutting off and holding a piece of skin. Fig. 87, Part V., *Tiemann's* "*Armam. Chirurgicum.*"

Grain Car. (*Railway.*) A box car, with light door, used for conveying grain in bulk.

Grain Clean'er. A device to remove imperfect or blasted berries, chaff, weed seeds, dirt, dust, or other trash from grain.

The grain separator does as much, but also sorts the grain into qualities. As the cleaning and sorting belong to the separator the subject is there considered. See GRAIN SEPARATOR; GRAIN SCOURER; SMUT MILL; BRUSHING MACHINE, etc.

Commercial wheat is rarely pure. Besides dust, sand, sticks, clods, chaff, and straw, there are numerous seeds, etc., which must be separated from the wheat before grinding. Such are several varieties of wild onions, vetches, peas, parsley, beans, radishes, mustard, chess, oats, grass-seed, cockle; besides blasted kernels of wheat, rust, ergot (smut).

Shriveled or blasted berries are in milling resolved into bran, and the flour discolored and rendered less nutritious. Some foreign seeds impart unpleasant taste, some are unwholesome, others discolor the flour.

Many mechanical devices are used to separate the offal from the pure grain; acting by gravity, meshes of varying size, rolling over a surface, exposed to a blast, a percussive impulse, pockets of varying size and shape, etc. See GRAIN SCREEN; GRAIN SEPARATOR; SMUT MILL. Also list under GRAIN, etc.

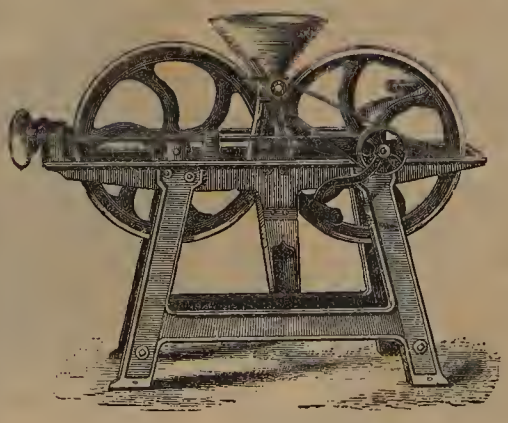
Fig. 1233.

Grafito Tile by Solon.

Grain Clean'ing and Grind'ing. See under the following heads: —

Army mill.
Aspirator.
Back-lash spring
Bag holder.
Bail.
Barrel bolt.
Bolt cleaner.
Bolt feeder.
Bolting cloth cleaner.
Bolting mill-stone.
Bone mill.
Bosom staff.
Bran baler.
Bran duster.
Bran packer.
Bray plank.
Bridge pot.
Brush-finishing machine.
Brushing machine.
Buckwheat huller.
Buckwheat shucker.
Buhr.
Buhr dresser.
Buhr driver.
Buhr rubber.
Chop separator.
Corn cleaner.
Corundum tool.
Cracking machine.
Creeper.
Cylinder grinding machine.
Cylinder mill.
Damsel.
Decorticator.
Degerminator.
Disintegrator.
Driver.
Dust collector.
Elevator.
Elevator boot.
Exhaust purifier.
Facing machine.
Facing tool.
Flour bolt.
Flour bolting chest.
Flouring mill.
Flour packer.
Furrow-dressing machine.
Furrow-gage staff.
Furrow rubber.
Furrowing machine.
Grader.
Grain cleaner.
Grain damper.
Grain dryer.
Grain mill.
Grain scourer.
Grain screen.
Grain separator.
Grain sifter.
Grain smutter.
Grain sorter.
Grain steamer.
Grain toller.
Grain washer.
Granulating process
Grinding mill.
Grist mill.
Grits-grading machine.
Grits mill.
Grits purifier.
High grinding.
High milling.
Hominy mill.
Horse gears.
Hurst.
Husk frame.
Kibbling mill.
Leveling screw
Lighter staff.
Low milling.
Maize mill.
Malt crusher.
Meal cooler.
Middlings.
Middlings grinder.
Middlings mill
Middlings purifier
Middlings softening machine
Mill bush.
Mill driver.
Mill feeder.
Milling
Milling process.
Mill pick.
Mill spindle.
Millstone.
Millstone alarm.
Millstone bush.
Millstone crane.
Millstone curb.
Millstone dresser.
Millstone driver.
Millstone exhaust.
Millstone facing machine.
Millstone feed.
Millstone hoist.
Millstone leveler.
Millstone lift.
Millstone spindle.
Millstone ventilator.
Mixing machine.
Molarimeter.
New process milling.
Oatmeal machine.
Oat mill.
Oil bush spindle.
Pearling.
Pointing.
Portable mill.
Process milling.
Proof staff.
Purifier.
Red staff.
Riddle sorter.
Roller mill.
Sack filler.
Sack lifter.
Sack packer.
Sack truck.
Scalping.
Scourer.
Sectional mill.
Semolina machine.
Semolina separator.
Semolina sifter.
Separator.
Shoe.
Sifter.
Sifting machine.
Smut machine.
Smut mill.
Smutter.
Stone clearer.
Stone separator.
Toller.
Tolling machine.
Tomkin post.
Tram pot.
Tram staff.
Unbranning machine.
Vertical mill.
Vertical-stone mill.
Wheat brush.
Wheat cracker.
Wheat damper.
Wheat grader.
Wheat heater.
Wheat magnets.
Wheat scourer.
Wheat separator.
Wheat steamer.
Winnowing machine.
Yoke lever.

Fig. 1234.



Bodin's Grain Crusher (*French*).

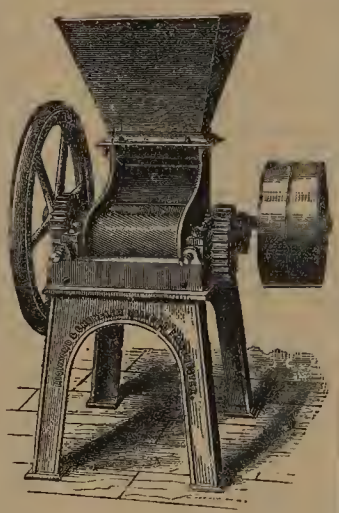
Grain Crush'er. A machine for mashing grain for feed, in order to render it more easily digested. It is largely used in Britain and in France, especially with beans; oats are, however, roughly broken or ground in many cases.

The bean crusher is known as a *kibbler* in England; the grain crusher as a *concasseur* or an *aplatisseur* in France.

Fig. 1234 shows the *aplatisseur* of Bodin, of Rennes. The grain issues from the hopper in quantities regulated by the feed-wheel, and falls between the flat surfaces of the two large rollers (0.70 meter diameter), one of which is driven by band or pulley, while the other is moved by contact. A set-screw regulates the distance between the two rollers, and a spring permits them to separate should a stone or foreign body intrude between them.

The work by hand is 22 gallons per hour.

Fig. 1235.



Grain Crusher. (*British.*)

The grain crusher of Richmond & Chandler, of Salford, England, is shown in Fig. 1235. The rollers are ridged so as to make it a rough grinding operation. It is used for beans, peas, oats, barley, maize, flax-seed, or malt

The "set" of the rollers is regulated by means of two thumb-screws in front of the machine, so that the grain may be crushed to the required degree of fineness. The feed of the grain to the rollers, according to the force applied to the machine, is determined by a small regulating wheel

Machines for crushing oil-cake for cattle and sheep feed are very commonly used in Europe. See Fig. 498, page 152, *supra.*

Grain cutter (feed), *Pini*, Ger. * "*Engineer*," xlvi. 434.
Wilhelm, Austria . . . . * "*Engineer*," xlvi. 434
Crusher, *Von Horde*, Austria * "*Sc. Am Sup.*," 938, 2755

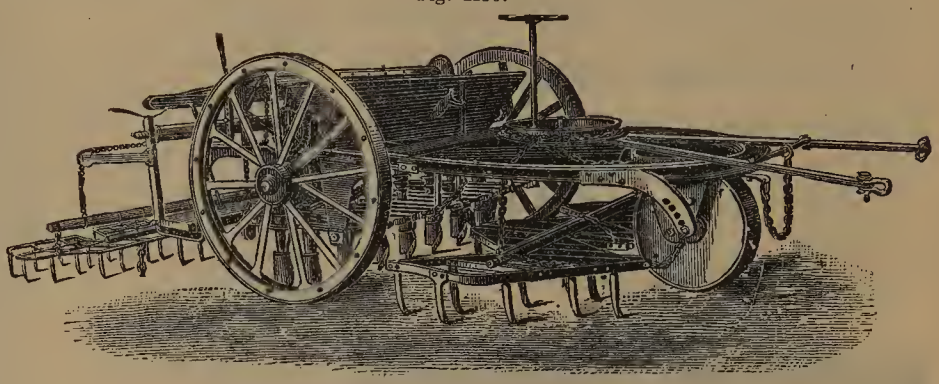
Grain Cut'ter. A machine for breaking grain for feed. See GRAIN CRUSHER.

"*Scientific American Supplement*," * 2755.

Grain Damp'er. An apparatus or attachment to dampen grain before grinding. It is done by wetting or steaming. See WHEAT STEAMER.

Grain Door. (*Railway.*) A close-fitting inside half-door for the doorway of a grain car.

Fig. 1236.



Fowler's Combined Drill and Harrow. (*Steam Culture.*)

Grain Dress'er. A machine for cleaning and dressing grain before grinding.

See GRAIN SEPARATOR; GRAIN SCOURER; BUSHING MACHINE, etc. See list under GRAIN CLEANING AND GRINDING.

Vangelder . . . . * "*Scientific American Sup.*," 1620.

Grain Drill. A machine for sowing grain in rows. See WHEAT DRILL, Figs. 7163–7168, pp. 2761–2763, "*Mech. Dict.*"

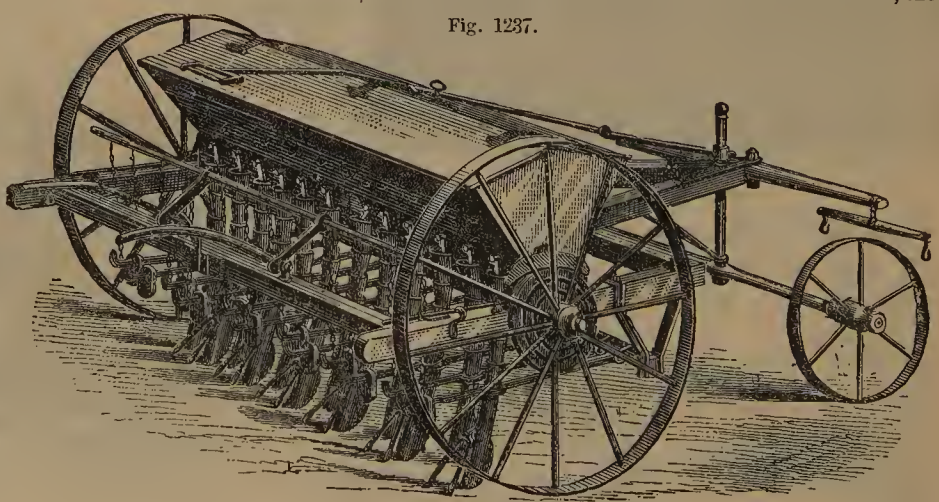
The combined drill and harrow, Fig. 1236, is one of the implements of the British steam culture.

It has a light cultivator or heavy harrow in front of the seeding colters, and a light covering-harrow following the same. The seed-drill itself, even of the largest width, requires but so small a fraction of the power of the engines, that it has been combined with the harrows. The drill has a width of 9′. In turning around, the heavy harrows are lifted by the power of the engine, and the whole implement moves at once on to new ground. The automatic lifting and turning action is described in connection with the turning cultivator, Fig. 739, p. 234, *supra.* See also "*Paris Exposition Reports*" (1878), v. 87.

The Gautreau drill (Fr.), Fig. 1237, has a fore carriage (*avant-train*), which is controlled by the workmen at the rear of the machine, and serves to guide the drill. The steering-lever is seen trailing backward and resting on the top of the seed-box. In the English drills this duty is frequently allotted to a man in advance of the hopper-box, walking between it and the fore carriage.

The European shovels, for the English and French agree in this, are nearly vertical, trailing a little backward in fact, and are forced into the soil by means of a weighted lever of the second order attached to each. One or more cast-iron weights are placed on the end of the lever, according to the hardness of the ground, and the result is no small addition to the weight of the machine, and would be needless were the shovels made *hooking* so as to draw into the soil, the

Fig. 1237.



Gautreau's Grain Drill. (*French.*)

point ranging forward in the manner of the ordinary plow, which keeps itself in the ground by virtue of the mode of presentation of its point.

Smyth's telescopic drill-tube (Br.) shown in Fig. 1238, is a substitute for the caoutchouc tube, which is not so popular in Europe as it deserves to be.

Fig. 1238.

Telescopic Drill Tube.

It consists of three parts, slipping easily one within the other. The material is sheet-iron, and the conductor proper may be said to consist of two tubes, b^1 b^2, discharging into a spheroidal cup, *c*, which rests on the bar *d*, and discharges behind the share which opens the furrow. The tube b^3 suspended by chains *g g*, is merely an envelope to prevent the entry of rain, clods, or wind into the tube, to clog it or disturb the fall of the grain from the spout *a*.

See also CORN DRILL, Fig 691, p. 222, *supra;* GRAIN DRILL, 5 figures, pp. 1002–1004, "*Mech. Dict.*," and WHEAT DRILL, pp. 2761, 2763, *Ibid.*

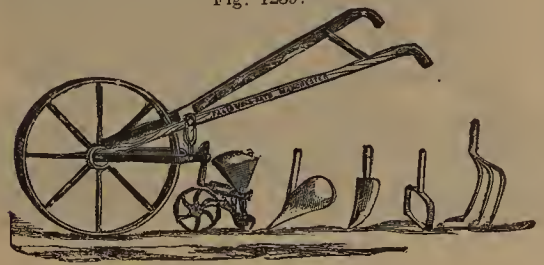
The English garden plow and drill, Fig. 1239, consists of one light steel shovel, for marking out rows to plant, or for loosening up the ground after the plants are up. Also a drilling attachment; a small steel plow for hilling up the rows; a cutter for exterminating weeds, and a rake for pulverizing the ground. The tools being optionally attached to the stock.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, contains notices and views of the following:

See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 103–119.

Grain drill	*Gautreau*, France.
Grain drill	*Smyth*, England.
Kuhn's grain drill, "Farmer's Friend"	United States.
Shiftable feed-movement of grain-drill	France.
American change wheel arraugement	United States.
Telescopic seed-tube	*Smyth*, Englaud.

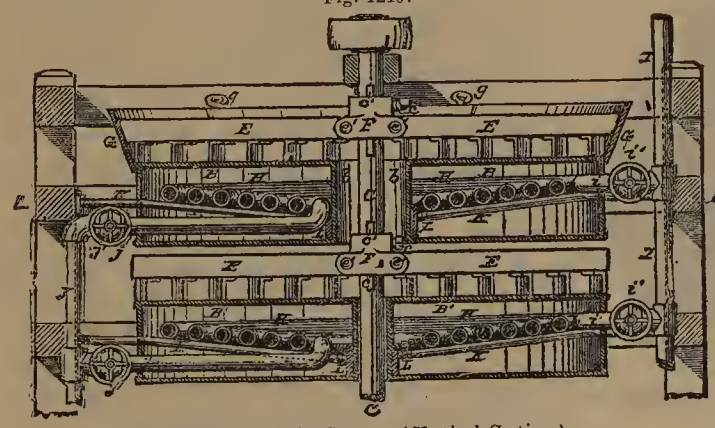
Fig. 1239.



English Garden Plow and Drill.

Turnip and beet seed drill	*Corbett & Peale*, England.
Grain and seed drill	*Guilleux*, France.
Broadcast seeder	*Smyth*, England.
Seed sower	*Rasmussen*, Denmark.
Broadcast seeding barrow	*Hunt & Tawell*, England.
Broadcasting plate	France.
Broadcast seeder	*Pernollet*, France.
Combined drill and fertilizer	"Farmer's Friend," U. S.
Fertilizer sower	*Josse*, France.
Combined beet seed and fertilizer drill	*Smyth*, England.
Beet seed planter	England.
Cup feed	England.
Brush-wheel feed	England.
Provençal plow-drill	*Magnan*, France.
Rayonneur or marker	*Bodin*, France.
Seed planter	France.
Seed planter	France.
Hand seed-drill	France.
Garrett, Br.	* "*Engineer*," xlvii. 467.

Fig. 1240.



Roper's Grain Dryer. (*Vertical Section.*)

Fig. 1241.

Roper's Grain Dryer. (*Plan.*)

Grain Dry'er. An apparatus or machine for artificially drying damp or heated grain.

Figs. 1240, 1241 show Roper's apparatus. *A* is the frame of the dryer, supporting the drying-pans *B B'*, through the center of which passes the driving-shaft *C*, carrying the rakes *E*, the teeth of which are so inclined as to carry the grain inward and outward on alternate pans. The grain is carried inward on one pan and discharged through a central opening, *b*, and is carried outward in the next pan of the series and discharged over the edge into the pan beneath.

H is a coil of steam-pipe, one of such coils being provided for each of the pans.

The grain or other material is supplied to the upper pan near its periphery, and carried inward to the central discharge, where it drops on to the pan *B'* beneath, on which it is carried outward and drops from the periphery of the pan on to the flaring edge *G*, and top of the pan beneath.

On the estate of Baron Ilorsky, in Bohemia, is a granary, provided with an elevator for the purpose of carrying the grain to the uppermost of a series of perforated floors or shelves, by means of which the grain can be made to fall in numerous slender streams through successive air spaces to the hopper at the bottom, from which the grain is again carried in the buckets of the elevator to be discharged on the upper shelf, and so made to go round and round until the desired dryness is attained.

Coiguet's apparatus is designed to dry grain and seeds without destroying the life of the germ. For this purpose the articles to be dried are placed upon perforated stages and traversed by a current of air from above, downwards, heated to the proper temperature, from 104° to 122° Fah., which he finds best to answer his purposes. A still higher temperature (namely, from 300° to 310°), applied in the same apparatus, enables him to dry certain animal matters, intended as manures, without causing the loss of their nitrogenous material; but, as such a temperature of dry air would be apt to cause combustion, he replaces this by superheated steam.

There are many typical forms of grain dryers; fan, pans, screens, chutes, traveling aprons, etc. See several instances, pp. 1004, 1005, "*Mech. Dict.*"

Steam, *Cutler.*	* "*American Miller*," vi. 93; x. 161
Stacey	* "*Scientific American Sup.*," 240.
Standing	* "*American Miller*," iv. 105.
Wallace	* "*American Miller*," iv. 5.

Grain El'e-va'tor. An apparatus for lifting or transferring grain. See ELEVATOR.

"The pneumatic grain elevator of Renhaye consists of a centrifugal ventilator, the suction pipe of which is carried to a receiver placed upon the level to which the grain is to be carried. From the same receiver the supply pipe runs to the place from where the grain is to be lifted. Between the openings of the suction and the supply pipe of the receiver is an inclined plane, which throws the grain downward. A screen prevents the grain from entering the suction pipe, through which only the dust is carried off. A piston regulator at the lower end of the supply pipe acts in such a manner upon an adjustable nozzle that the proper proportion between the amounts of air and grain admitted is automatically maintained. The principle upon which this pneumatic elevator acts is that when solid particles in movement in a pipe are mixed with air, a semi-fluid is formed in which the pressures vary in accordance to the laws governing ordinary fluids." — "*Revue Industrielle.*"

Rennie, Br. . . . . * "*Engineer*," xlix. 28.

Grain Fan. See FANNING MILL; WINNOWING MACHINE.

Grain'ing. (*Leather.*) Giving to leather a granular appearance on the grain side by either the graining board or pebbling machine. The term originally meant raising the natural grain or marking of the leather on the hair side; but now is also applied to making artificial markings in imitation of morocco, hog-skin, etc.

Grain'ing Board. (*Leather.*) A rectangular piece of wood, the upper surface a plane; the lower one is convex, and fluted with parallel grooves, which run perpendicular to its length. The grooves are coarse or fine, as occasion requires.

Grain Meas'u-rer. See GRAIN REGISTER; GRAIN SCALE.

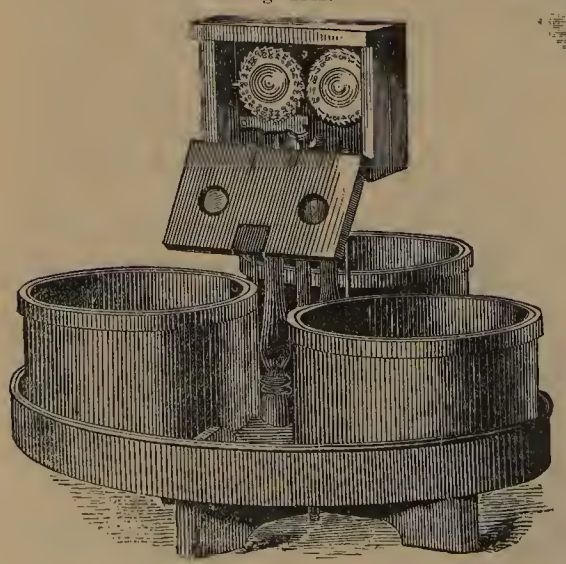
Grain Mill. See GRINDING MILL.

See also CYLINDER MILL; DECORTICATOR; GRAIN CRUSHER; CORN MILL; FLOUR MILL; MILLING, and list under GRAIN, "*Mech. Dict.*," *et supra.*

Grain Reg'is-ter. An apparatus to keep count of half-bushels moved away from the delivery spout of a threshing machine.

The half-bushels are moved consecutively under the spout, and as an empty one replaces the full one removed the register tallies one. The count is kept by the usual system of wheel, as in the gas meter. The shutter of the tally chamber is shown down, but the count may be observed through the windows of the closed shutter.

Fig. 1242.



Grain Register for Threshers.

Grains. An eel spear. One is shown with five prongs. Fig. 1243.

Grain Scale. A machine for weighing grain in commercial quantities and keeping tally of drafts.

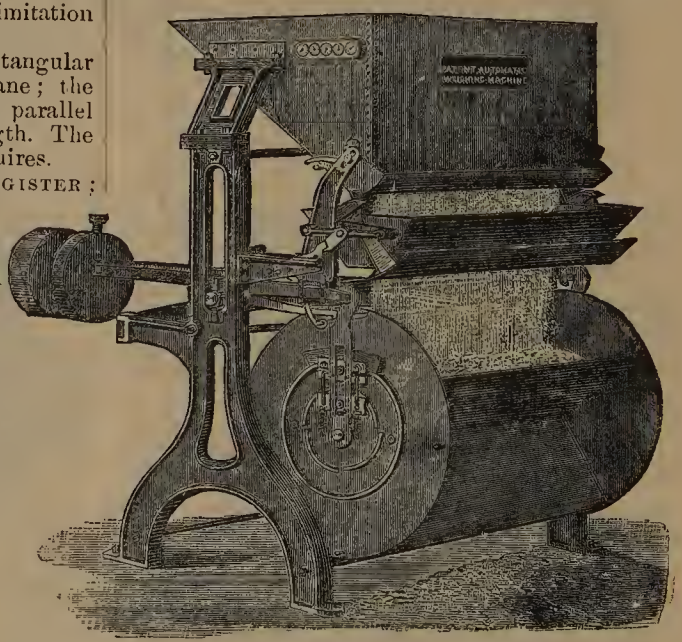
Fig. 1243.

Grains.

The machine shown in Fig. 1244 is by Baxter, of London. It is placed under a chute or spout, which delivers the grain with regularity.

Having determined the quantity that shall be registered at each tip of the cylinder, and adjusted the weight accordingly, the operation of weighing may commence. The grain being led into the hopper, descends into the compartment beneath, until the quantity nearly equivalent to the weight indicated on the steelyard has fallen; the diminishing valve then reduces the stream of falling material to such an extent that its momentum is not sufficient to influence the beam; the actual weighing here commences, and as soon as a correct balance is attained the cut-off instantly stops the supply to the cylinder; at the same moment the cylinder is released; it then turns and discharges its load. Being lightened, it rises, presenting the next compartment to be filled, opens the cut-off (letting out the grain collected therein), and the diminishing valve actuates the index, and the operation is repeated.

Fig. 1244.



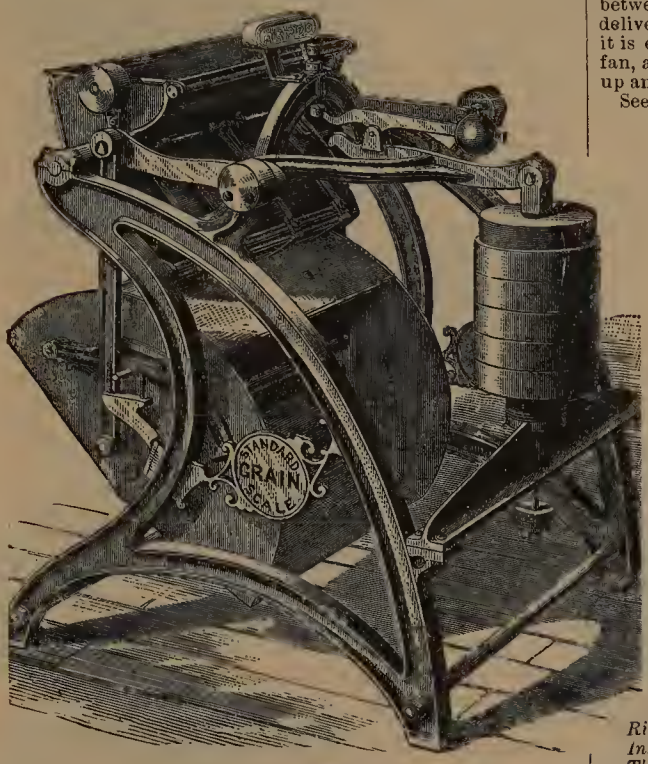
Baxter's Grain-weighing Machine.

The "Standard" grain-weighing machine is shown in Fig. 1245.

It consists of a balance beam, from one end of which, upon knife-edge pivots, is suspended a tilting grain-bucket. The bucket is divided into two equal compartments, and is held in position to receive grain by means of gravitating latches, pivoted to the suspenders which hang upon the knife-edge bearings and sustain the bucket. From the opposite end of the beam is suspended the balancing weight. The balancing weights are so arranged that the lower or main weight, in conjunction with the small weight on the supplemental beam, exactly balances the empty bucket, and the grain weight balances the weight of the grain to be taken in the bucket at each dump. Immediately above the grain bucket is placed the spout, which is gradually tapered to the mouth at the lower end, through which the grain is delivered into the bucket. Mounted upon the side of the spout are two long, narrow plates, the larger of which is known as the main, and the smaller as the supplemental cut-off, which are operated by means of fixed clutches upon the shaft.

When the grain-bucket is at the highest point of its travel, both the cut-off and the drip-plates are entirely withdrawn from under the mouth of the spout, and the grain flows freely into the bucket. When so much grain as is represented by the difference between the supplemental weight and the grain weight is taken into the bucket, the bucket and forward end of the beam descends a short distance, until the supplemental weight rests upon the beam, when the

Fig. 1245.



"Standard" Grain Scale.

bucket lacking grain to the extent of the supplemental weight is checked in its downward movement, and pauses until the requisite quantity to complete the load has been taken. The main cut-off plate is now closed, leaving open only a narrow slit, through which passes the final quantity of grain, necessary to complete the load. The bucket then descends until the latches holding it in position are released by check-pieces on the frame of the machine, when it turns on its shaft, discharges the weighed load of grain, and returns to repeat this operation as long as grain is supplied to the scale. The discharge of the grain from one compartment of the bucket presents the opposite compartment for the reception of grain as it rises under the spout.

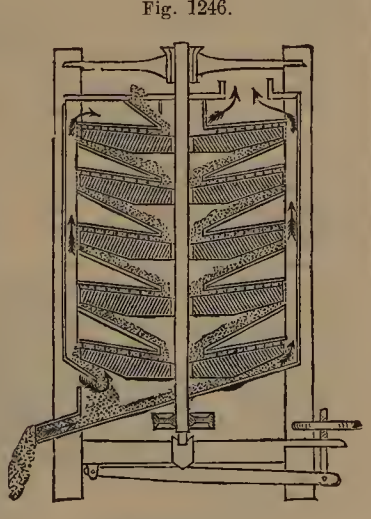
Compare: —

Meter, *Barnard* . . . . * "*Scientific American*," xliii. 259.
Scale, *Cherry* . . . . . * "*Scientific Amer.*," xxxvii. 66.
Weighing machine, automatic, *Kaiser*, Austria . * "*Engineer*," l. 404.
Weighing and measuring mach., Austria . . . * "*Engineer*," l. 458 (Fig. 43).
"Standard" . . . . . * "*Iron Age*," xxv., April 15, p. 1.
Sampler, *Gent* . . . . * "*Scientific Amer*," xxxvi. 227.

Grain Scour'er. A machine for removing the fuzz from, and polishing the berry. Used for wheat, rye, and buckwheat.

The grain follows a circuitous passage; falling down a funnel to the center, it is caught upon the rough sandstone disk and thrown out centrifugally, to repeat the action again and again till it reaches the bottom and the discharge spout. The blast which carries off the fuzz ascends through the machine, passing in a contrary direction to the grain.

Fig. 1246.

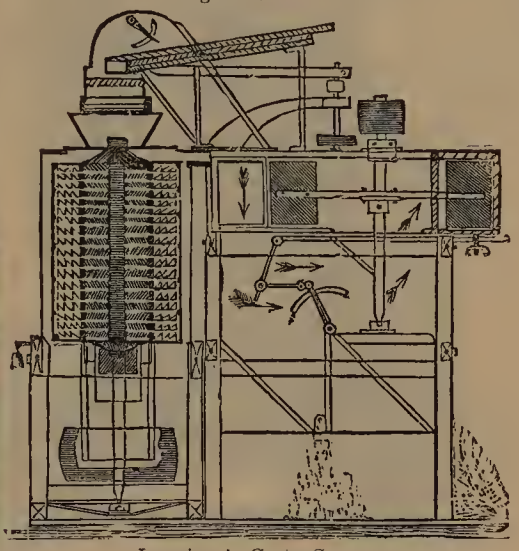


M'Neil's Grain Scourer.

In Ingraham's machine, Fig. 1247, the wheat descends between the brush cylinder and the rough concave, and is delivered with all the fuzz and offal into the chamber, where it is exposed to the current of air passing to the aspiration fan, and is sorted into two grades while the dust is carried up and blown out.

See also BRUSHING MACHINE, p. 141, *supra*.

Fig. 1247.



Ingraham's Grain Scourer.

Richardson . . . . . * "*American Miller*," vi. 22.
Ingraham "Excelsior." . * "*American Miller*," vi. 22
Throop . . . . . * "*American Miller*," viii. 454.
Knox . . . . . * "*American Miller*," viii. 223.
Trimmer . . . . . * "*American Miller*," viii. 321.

Grain Sep'a-ra'tor. 1. The more common form of machine for ridding grain of chaff, husks, dirt, and dust is still the fanning-mill or winnowing machine, but late years have introduced a number of more speedy and excellent methods. The French especially have attained a degree of accuracy in sorting grades of grain, different grains, and grain from offal and dirt. Both in Britain and in France the farmer's implements for cleaning grain are in great variety. In milling implements our variety is the greater.

These machines may be summarized as acting by

a. Blast.
b. Aspiration.
c. Graduated sieve.
d. Adjustable cylindrical sieve.
e. Perforated and dented plates.
f. Percussion.
g. Projection.

a. (*Blast.*) See FANNING MILL, p. 825, "*Mech. Dict.*" WINNOWING MACHINE, p. 2787. *Ibid.*

b. (*Aspiration.*) See ASPIRATING WINNOWING MACHINE, Fig. 119, p. 51, *supra*. Also, GRADER, Fig. 1231, p. 410, *Ibid.*

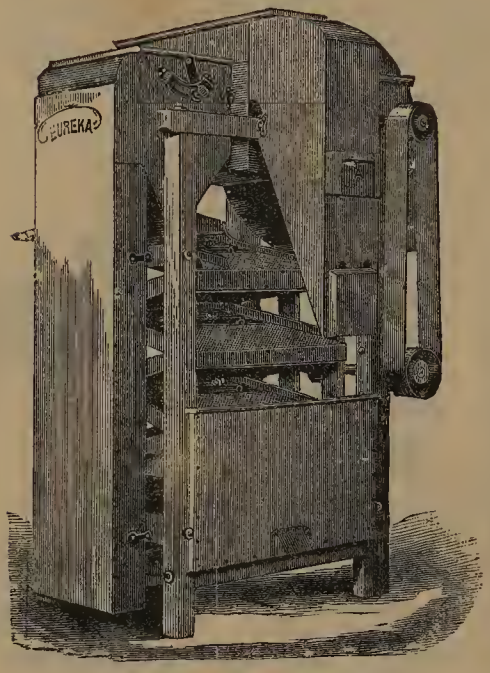
The "Eureka" separator, Fig. 1248, acts in large degree upon the aspirator principle, although it embraces many other features, shaking screens, etc. It has zig-zag arrangement of screens, combined with a lateral shake movement, and is intended to rid wheat of oats and other impurities.

The wheat is first fed into a suction separator, which removes the dust and light impurities, the dust passing to the fan, while the chess (cheat) and such other seeds as are of some value for food are discharged separately. The wheat then falls on to a shaking screen and distributor, which throws off straws, heads, sticks, etc., and distributes the grain evenly the entire length of the upper screen. It then passes over a series of screens which rid it of oats. It then passes to a cockle-screen which also rids it of sand and small seeds, and thence passes to a separating leg, where the operation is completed.

c. (*Graduated Sieve.*) An instance of this is afforded in Fig. 1249 of Plate XX., which represents the grain cleaner and separator of Boby, Bury St. Edmund's, England.

The machine has a wooden frame and a long inclined

Fig. 1248.



"*Eureka*" *Separator.*

sieve, which receives at its upper end the grain from a hopper. The grain issues in a thin sheet from the hopper, and first falls upon a separator, which arrests stones and large trash, allowing the grain to pass down and be discharged in a sheet as wide as the inclined sieve beneath. This sieve receives a longitudinal agitation by means of a pitman from a crank on the horizontal axis, which is revolved by hand-crank or belt, as the case may be.

The longitudinal wires of the shaking sieve are carefully stretched, and are spaced so as to retain plump grains and allow broken or thin grains to pass, and the meshes are kept open by thin blades, which also rectify the positions of the passing grains and bring them into parallelism with the wires along which they pass in their descent from the stone-separator to their point of ultimate discharge.

The machine is particularly intended for the cleaning and sorting of barley for malting, and the necessity of a perfect action in this respect is set forth in the statement following:

1. It is essential that, in advance of the payment of the impost duty (internal revenue or excise tax) on the steeped malt, the entire mass must be rid of matters which produce deficient quantities of saccharine extract.

2. It is necessary to separate all light grains before making the malt, for otherwise they will become too damp or saturated in the time necessary for the sufficient steeping of the good grain.

3. The thin or light grains must be absolutely separated from the full-sized grains before making the malt, for otherwise the thin grains pass unbroken between the rollers in the process of crushing the plump grains.

The operating surface of the Boby sieve is stated to have six times the area of the usual rotary sieve, and, the grain being spread over so great a surface, each light grain is sifted out in passing from the hopper to the discharge; in the rotary sieve the acting surface is only at the lower side, estimated as only embracing, at any one time, one-ninth of the peripheral.

d. (*Adjustable Cylindrical Sieve.*) A peculiar character of sieve, of cylindrical form, and capable of having the meshes made of any desired interval, within certain limits. The machine of Penney & Co., of Lincoln, England, is shown in three Figs., 1250, 1251, 1252, of Plate XX.

It is made of various sizes and prices, and there are also special constructions for certain purposes, such as the cleaning and grading of malt, the cleaning of peas and beans, etc. The latter-mentioned articles require such a very different range of adjustability that the machines cannot be economically made to suit the wide ranges of work.

The machine can be adapted for all species and qualities of grains (within profitable limits, as stated) by means of varying the distance between the wires.

The cylindrical screen may be said to consist of one continuous wire laid spirally around the longitudinal bars which form the skeleton of the screen. One of the heads is adjustable longitudinally of the axis of rotation, slipping thereon, and as it is drawn toward the extremity, the spaces between the laps of wire become larger, and, conversely, the intervals are diminished as the heads are approached by the reverse adjustment. Spiral springs mounted upon the exterior rods, as in Fig. 1251 (*ressorts extérieurs*), or within the cylindrical screen, as in Fig. 1252 (*ressorts intérieurs*), keep the screen extended longitudinally.

The different kinds of brushes used for cleaning the meshes of the screen are shown in Figs. 1251, 1252.

Regularity of passage through the length of the screen is secured by a spiral flange or rib projecting inward from the cylindrical surface, which tumbles the grain along until it pushes it out at the end. Dry and broken grain is retarded, while damp grain is expedited in its passage, the rate being thus made uniform, though the condition of the grain may vary.

The machine shown in Fig. 1250 is composed of two parts, of which the second and lower has screen openings of greater interval than the first part. It is intended for grain which contains stones, ordure of vermin, or other matters larger than the wheat or the grain to which the machine is for the time adjusted. The stones and other large matters pass clear through the screen and into a spout, which ejects them at the side; the good grain passes over the meshes of the first part of the cylinder and is divested of the small and broken grains which pass the meshes; it then itself falls between the meshes of the second portion of the cylinder, and is discharged by a spout at the end, while the stones pass on, and so to the side spout as stated.

e. (*Perforated and Dented Plates.*) The riddle-sorter of Pernollet, Paris, shown in Fig. 1253, Plate XX., is made in several forms, some adapted for the ordinary uses of the farm in cleaning grain, and others for special service, such as cleaning green peas, beans, lentils, coffee, cacao; for sorting different kinds of barley for brewers, etc.

The machines, in some cases, are specially constructed for a given purpose, but in others the change of the perforated iron plates for others of larger or smaller apertures is sufficient to adapt the machine to the required purpose.

The grain is placed in the hopper, its rate of feed depending upon the slide in the bottom. An oblique spout conducts the grain fairly within the rotating cylinder, whose four compartments, being clothed with punched iron screens of different apertures, sort the different kinds and drop them into boxes beneath. The respective screens have round holes of different sizes, or long holes, to detain or to allow to pass, as the case may be, seeds of varying sizes and shapes.

Marot's grain cleaner, shown in section in Fig. 1254, Plate XX., shows a new feature in grain-cleaners, namely, *indented plates*, which form pockets to carry up seeds on the inside of the cylinder and drop them into a tray, which carries away the seed thus segregated from the other contents of the rolling cylinder.

The *indented plates*, of which detached portions are shown in Fig. 1255, Plate XX., are sectional cylindrical jackets, like the perforated covering of the Pernollet machine just described, but instead of holes they have pockets or cups, made by punching or drilling, and form cylinders around the axis of rotation.

As in the case of the Pernollet machine, and others of its class, the enveloping cylinder has perforations in its four sections, of varying sized apertures, according to the special work to which it has to be applied; so in the case of the Marot machine, the indented jacket, with its recesses facing inward, has pockets of such size and shape as to catch and hold special kinds of grain or of seeds which it may be required to abstract from the mixed or foul material fed into the machine.

The new mode of screening compels the long grains to pass through round holes equal in size to their diameter, a result vainly sought until now, and which can be readily understood in looking at the perforated cell, the entrance to which is three times as large as the perforation, being in fact funnel shaped.

It will be well to enter into a detailed statement of the functions of the different parts for the better understanding of the process and operation, and the perfection attained.

The grain-sorter is composed of a dented cylinder inclosed in a wooden frame, which is surmounted by a hopper, *T*, and in prolongation thereof is a double inclined riddle, agitated by connection with a wheel.

The upper riddle, *g*, retains all the impurities and large round grains; the lower riddle, *g'*, allows passage to the rye-

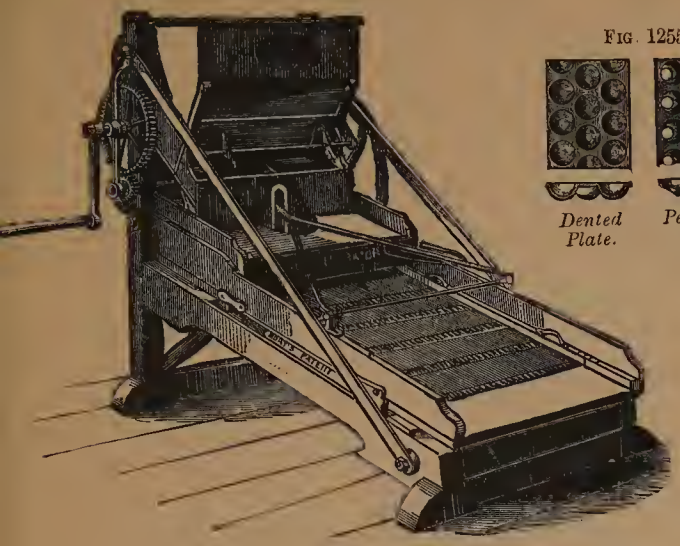
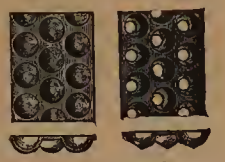


FIG. 1249. *Grain Cleaner and Separator.*

FIG. 1255.



Dented Plate. *Perforated Plate.*

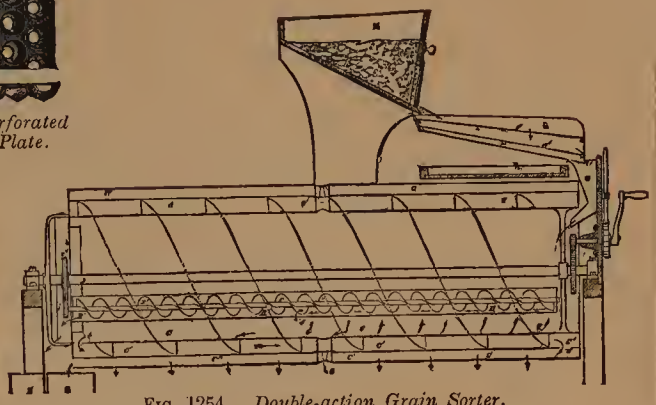


FIG. 1254. *Double-action Grain Sorter.*

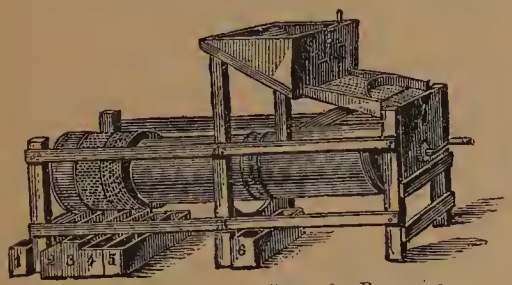


FIG. 1256. *Barley Sorter for Breweries.*

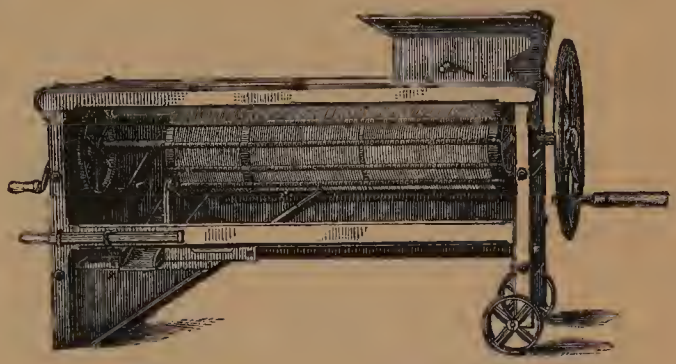


FIG. 1250. *Adjustable Rotary Screen (with Stone Separator).*

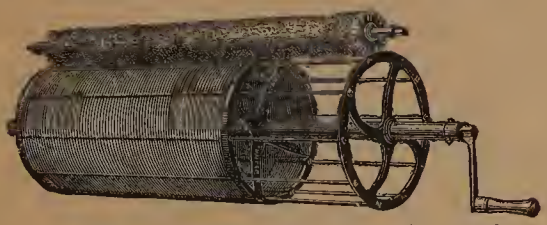


FIG. 1252. *Adjustable Rotary Screen (dismounted).*

FIG. 1251. *Adjustable Rotary Screen (dismounted).*

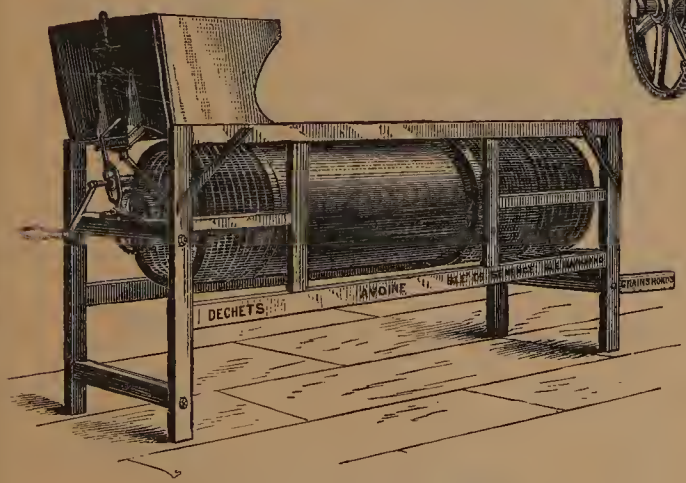


FIG. 1257. *Sifting-sorting Separator.*

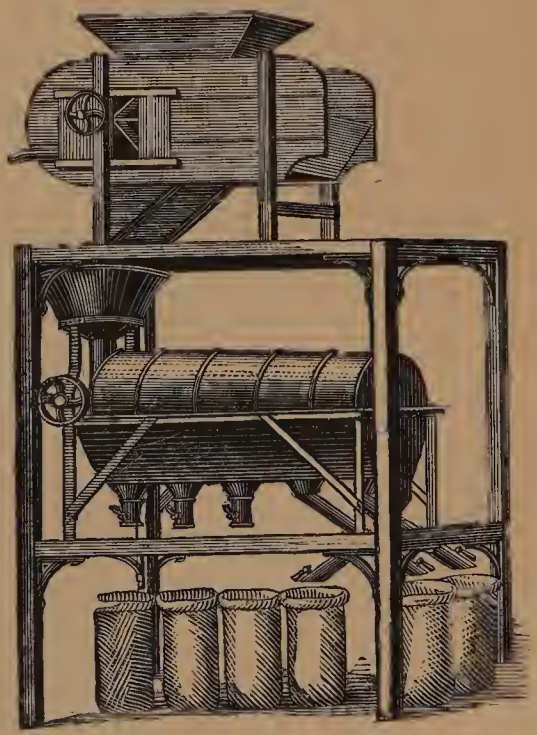


FIG. 1258. *Cleaning and Separating Machine.*

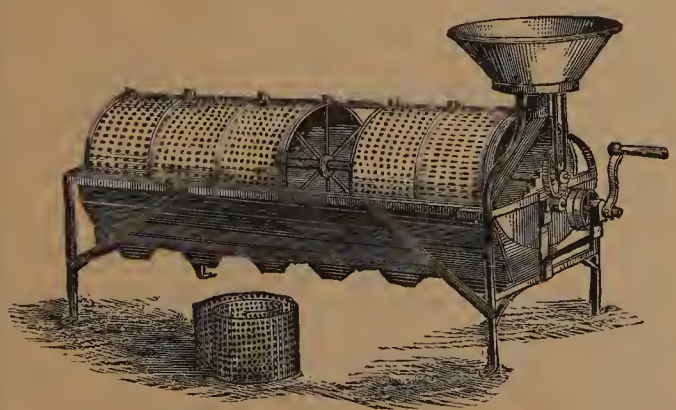


FIG. 1253. *Riddle Sorter.*

See page 416.

grass seed, small seeds, and refuse, which fall into a tray, *h*, placed athwart the frame.

The wheat falls off the end of the riddle into a hopper, *E*, and thence into a spout, which conducts it into the interior of the cylinder *C*. In a central position in the cylinder beneath the axis *j* is a trough, *R*, in which is a conveyor, *r*, rotated by a pinion, *i*, from a wheel, *i'*, on the axis *j*.

The first part of the cylinder *C* is studded with indentations (concave interiorly, but not perforated), as shown in the left portion of Fig. 1255, Plate XX., which is a portion of one of the plates.

These depressions are of such diameter that the wheat and round grains may lodge in them, and in the movement of the cylinder their contents are lifted and dropped into the trough *R*, while the barley and oats are prevented, by their length, from lodging in the cups, and, following the slope of the cylinder, are discharged at the opening *o*, at its mid-length.

The wheat and round grains, carried up the cups and caught in the trough *R*, are carried along by the conveyor *r*, and fall into the cylinder through an opening, *s*, at a point beyond the discharge, *o*, of the oats and barley. Here they come under the action of the second part of the cylinder, the inner surface of which has depressions of smaller diameter, suitable for carrying up the round grains, such as tares, but rejecting the wheat. The tares, etc., are dropped into the trough *R'*, which is a continuation of *R*, and, being pushed by the conveyor, are forced out at the end and led by a spout (not shown) into the box 1.

The wheat, deprived of oats, barley, and round grains (tares, mustard, rape, etc.), follows the slope of the cylinder to the point *t*, where it falls into the cylinder *C'*. It passes backward along the whole length of the cylinder, pushed by the helicoidal wings which form a conveyor on the periphery of cylinder *C*.

At the point *w*, beneath the place of first entry into the cylinder, the wheat, with some other grains not yet eliminated, falls into cylinder *C''*, which consists of plates both dented and perforated, concavity inward. The grain is caught in the cups and carried up, and, while the diameter of the holes is not sufficient to allow good wheat to pass, the shrunken grains, cheat, rye, rye-grass seed, etc., pass through the openings indicated by the lower row of vertical arrows, and fall upon the floor, while the clean wheat is discharged at the end into box 2.

Another machine is especially constructed for the separation of *crescute* from clover or lucern seed.

Marot's machine for the special use of maltsters and brewers, and shown in Fig. 1256, Plate XX., has substantially the same features in the main, but, in addition, it has three circular riddles at the delivery end of the machine, to separate the barley into three grades according to the diameter of the grains.

The object of the separation is to secure an even germination, as it is found that the different development or condition of the grain causes the sprouting to be more or less rapid; and, consequently, to mix different grades of barley is to obtain an uneven quality of malt, as the plumules and radicles are unevenly developed, indicative of different stages in the resolution of the components of the grain.

The sifting-sorting separator (*cribleur-trieur-diviseur*) of Caramija-Maugé, of Paris, is shown in Fig. 1257, Plate XX. It acts in the same general way as that of Marot, Fig. 1254, previously described, but carries the principle of separation to a fuller extent. It is intended to separate mixed wheat, barley, rye, oats, peas, vetches, cockle, cheat, etc.

The grain in the hopper on the left passes through a gate and by a tube to the interior of the rolling-screen. The first section removes small seeds and waste (*déchets*), and then the dents in the first portion of the cylinder raise the wheat and round grains and drop them into the interior tray, where the spiral blade drives them toward the second section of the cylinder. The long grains, oats and barley, are pushed along in the first section of the cylinder until they reach the exterior holes, at which they issue.

The wheat and round grains being conducted into the second section of the cylinder, as stated above, the round grains are picked up by the dented surface and raised so as to drop into the second interior trough, wherein a spiral works to thrust them out at the end, where they fall into the box shown at the right.

The second section of the cylinder has portions of differing fineness of mesh, sorting the wheat into qualities for seed and for market.

The result of the operation is five grades; reading from the left to the right, they are as follows: Waste, oats and barley, seed wheat, merchantable wheat, round grains.

Fig. 1258, Plate XX., is the separator of Pernollet, of Paris. It consists of a winnowing machine above and a cylindrical screen below, discharging the grades of grain and offal into separate bags.

The cleaning is done above and the separating below, the latter differing in no essential respect from some of those previously described. The machine is also by special adjustment adapted for sorting coffee, the product of the ground cacao, etc.

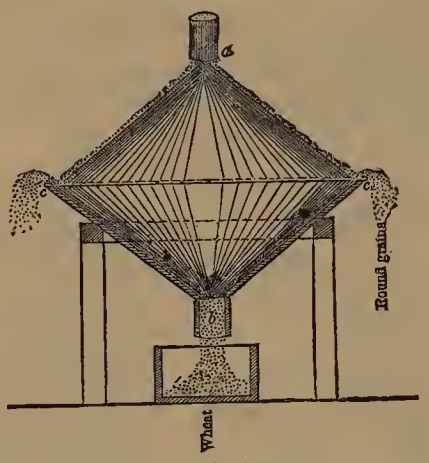
f. (*Percussion.*) This machine seems to be used but little out of France. Several ingenious forms of it are made by Hignette, Paris. It is especially intended to remove clods, and is shown under CLOD CLEARER, Fig. 637, p. 201, *supra.*

The tray has a rocking motion on pivoted legs, at the rate of 115 double strokes per minute. Grain falls from a hopper into the tray, and is bounced from side to side, angular blocks directing it to different discharge apertures.

g. (*Projection.*) A machine used in Austria, for the separation of round seeds from grain, is shown at Fig. 1257, in which advantage has been taken of the spherical form of certain of the foreign seeds to effect their removal.

The wheat, with its mingled mustard-seed, wild pease, and other round grains, is discharged through a tube upon the

Fig. 1259.



Conical Grain Separator.

apex of a varnished wooden cone, the slopes of which are inclined to the perpendicular at an angle of about 55°. The elongated wheat-grains slide to the bottom within a certain time, being retarded by friction. The round grains, however, rolling down the side of the cone, acquire very much greater velocity, and leap across a narrow opening at the base of the cone; while the wheat-grains, moving much more slowly, fall into the opening, and are received into a separate receptacle.

The spout *a* is adjustable. The round grains, striking the slender ledge at the base of the cone, bound or leap across the openings *c c*, while the long grains of wheat, moving at a slower rate, fall through and descend the incline to *b*.

The Vienna steam-mills have an endless apron stretched upon two equally inclined cylinders. The apron has a transverse inclination, and receives the grain at one end in a thin stream. The round grains roll off while the wheat grains travel to the end and are discharged into a box.

The principle of projection is also used in grading products of milling. See MILLING, *infra.*

2. A threshing machine, which see.

Dr. Knight's report on Class 76, Paris Exposition of 1878, gives views and description of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 187–199.

Aspirating winnower, *Girardin*	France.
Grain-cleaner and separator, *Robert Boby*	England.
Adjustable rotary screen, with stone separator, *Penney & Co.*, and others	England.
Riddle sorter. *Pernollet*	France.
Grain sorter. *Marot*	France.
Grain sorter, dented plate	France.
Grain sorter, dented and perforated plate	France.
Barley-sorter for breweries	France.
Sifting-sorting-separator, *Caramija-Maugé*	France.
Stone-clearer, *Hignette*	France.
Aspirating stone-clearer	France.

Refer also to: —

Cleaner, *Johnson* . . * "*Scientific American*," xxxiv. 262.
Millot . . . . . * "*Scientific American Sup.*," 2702.
Richmond . . . . * "*American Miller*," viii. 195.
Seck . . . . . * "*American Miller*," vi. 128.
"Triumph," *Slater* . * "*American Miller*," iii. 183.
Dresser, *Vangelder* . . * "*Scientific American Sup.*," 1620.
Dryer, steam, *Cutler* . * "*American Miller*," vi. 93, 161.
Stacey . . . . . * "*Scientific American Sup.*," 240.
Standing . . . . * "*American Miller*," iv. 105.
Wallace . . . . . * "*American Miller*," iv. 5.
Scourer, *Knox* . . . * "*American Miller*," viii. 224.
Ingraham & Beard . * "*American Miller*," vi. 22.
"Excelsior" . . . * "*American Miller*," vi. 22.
Richardson . . . . * "*American Miller*," vi. 22.
Throop . . . . . * "*American Miller*," viii. 454.
Trimmer . . . . * "*American Miller*," viii. 321.
Screen, *Barnard* . . . * "*American Miller*," iv. 115.
Separator, *Booth* . . * "*American Miller*," v. 38.
Jewell . . . . . * "*American Miller*," iv. 47
Kurth . . . . . * "*American Miller*," viii. 356.
"New Era" . . . * "*American Miller*," iv. 24.
Taylor . . . . . * "*American Miller*," vii. 8.
Sorter and smutter.
Rose, Switz. . . . * "*Engineer*," xlvi. 258.
Stone clearer . . . . Fig. 637, page 201, *supra*.

Grain Side. (*Leather.*) The side of a skin or hide from which the hair has been removed.

Grain Sift'er. See GRAIN SCREEN; GRAIN SEPARATOR.

Grain Sort'er. See GRAIN SEPARATOR, p. 415, *et seq.*; GRADER, page 410.

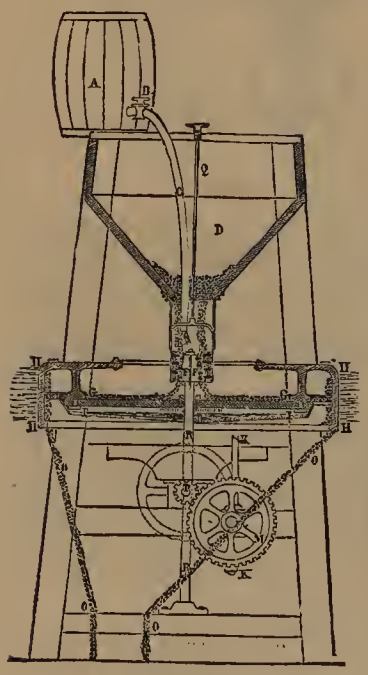
Grain Steam'er. See WHEAT HEATER.

Grain Tol'ler. A device for taking from a grist the miller's portion or toll.

See TOLL COLLECTOR, p. 2587, "*Mech. Dict.*"
* "*Mining and Scientific Press*" . . . . xxxvi. 297.

Grain Wash'er. An apparatus for washing grain previous to grinding.

Fig. 1260.



Grain Washer.

Fig. 1260 shows a French apparatus for this purpose. *H H* is a sheet-metal cage revolving on the vertical axis *R*; the latter also carries a spiral brush, *F F*, in the neck of the hopper *D*, down which the wheat and water are passed. Traversing together through the neck the wheat is washed, and both are discharged into the cage *H H*, which, being in rapid motion, rejects the water at its circumference and retains the wheat. The course of water being stopped, the revolution is kept up till the wheat is sufficiently dry, and it is then discharged into the hopper *O O*.

Rebel's system, French also, is an inclined cylinder.

Rose, Switz.
* "*Engineer*," xlvi. 258.

Grain Weigh'ing Ma-chine. See GRAIN SCALE, pp. 414, 415, *supra*.

Gramme Ma-chine'. The dynamo-electric machine of M. Gramme, celebrated in the history of the art. Fig. 893, Plate XI., *supra*

See . . . . . * "*Iron Age*," xxiii., Jan. 2, p. 9.
* "*Scientific American Sup.*," 2404.

Grand Feu. (*Ceramics.*) A French term, but frequently used in English treatises, signifying that the articles are baked in very highly heated kilns or muffles.

Gran'ite Ware. 1. (*Ceramics.*) A trade name (*w. g.*, white granite) of a kind of stoneware.

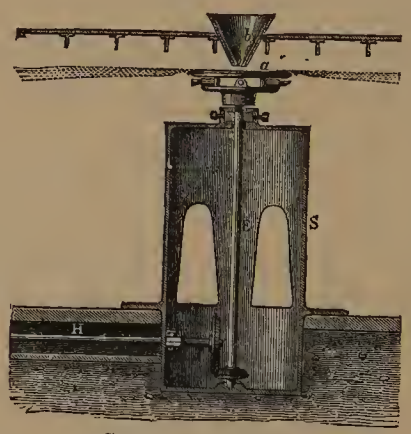
2. An enameled iron ware made by the St. Louis Stamping Company. It has a stone-like enamel of a gray color and remarkably adherent to iron, free from poisonous qualities and very durable.

Gran'u-la'ted Steel. (*Metallurgy.*) Melted pig-iron is run into a cistern of water; the grains put in a crucible with sparry iron ore, which yields oxygen to remove the carbon. The fragments are melted, and cast in ingots. *Uchatius steel.*

Gran'u-la'ting Ap'pa-ra'tus. An apparatus for the granulation of metals is shown in Fig. 1261. The object is to reduce the metal to fine powder or small particles so as to multiply the surfaces and facilitate oxidation, in their attack by acids.

The apparatus shown in Fig. 1261 is used for iron, copper and its alloys with zinc, lead, and tin. It consists essentially

Fig. 1261.



Granulating Apparatus.

of a vertical axis *E* put in movement by shaft *H* and gearing, the molten metal being poured through funnel *b*, upon the revolving disk *a* of terra-cotta, and dispersed centrifugally into the air (or water if necessary) which surrounds the cast-iron casing, *S*.

Gran'u-la'ting Ma-chine'. (*Gunpowder Making.*) The granulating machine works upon the broken pieces of powder cake, to reduce them into the proper size of grains.

It consists of two bronze side frames supporting four pairs of bronze toothed rollers placed on different levels and having their axes parallel and horizontal.

The first set is at the top of the machine, about 20′ from the floor, and the press cake, broken up between them, falls on to an inclined screen which conducts the fragments to a second pair of rollers. A succession of vibratory screens sorts the powder into grades and dust.

In the Petersburg arsenal the powder cake is broken into grains by placing it in sieves which contain a certain number of bronze balls. These sieves are attached to a vibratory frame, crushing the cake, the pieces falling through the bottom of the sieve into drawers beneath. The grains are subsequently dusted, glazed, and assorted. See Fig. 19 accompanying Appendix L, "*Ordnance Report*," 1877.

See also, *Ibid.*, 1879, Appendix I, Plate IV., Fig. 8, and description on pp. 104, 105.

Br., "*Engineering*" . . . . . * xxv. 138.

Gran'u-la'ting Pro'cess. (*Milling.*) The system of milling consisting in the repeated cracking of the grain and its fragments between rollers, instead of tearing it to pieces and reducing it to flour and offal between stones. The diagram, Fig. 1262, shows the gradations of the process.

See CYLINDER MILL; ROLLER MILL; MILLING, etc.

Middlings Mill, *Mills* . . . * "*American Miller*," v. 177.
Middlings mill, *Mills* . . . * "*American Miller*," vi 93; vii. 277.

Fig. 1262.

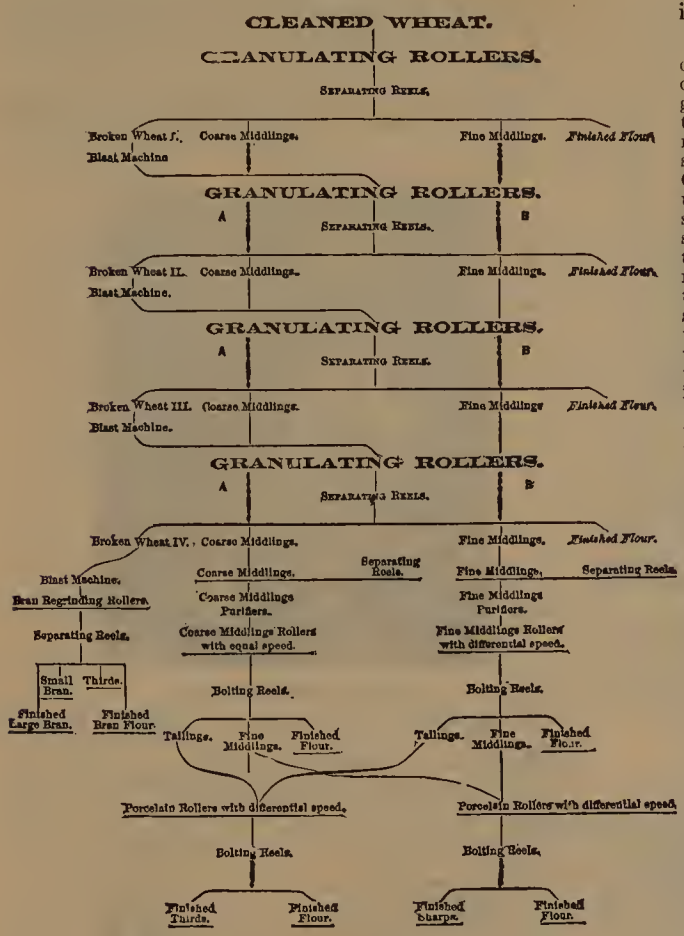


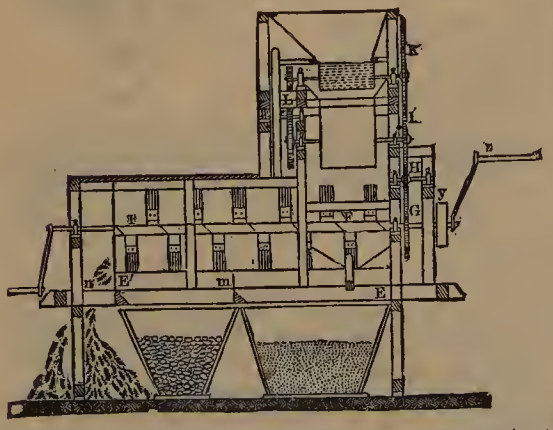
Diagram of Wegmann's Granulating Process.

Gran'u-la'ted Wood Pow'der. The invention of Captain Schultze, of the Prussian army.

Wood is sawed into fine veneers across the grain. These veneers are chipped into small cubes. The acids and soluble substances are removed, and the little cubes are treated with a mixture of 40 parts by weight of nitric acid (of 1.48 to 1.50) and 100 parts sulphuric acid (of 1.85), and set aside to cool. Six parts of wood is added to 100 parts of the acid, stirring constantly for 3 hours. The grains are dried in a centrifugal machine, washed in running water, boiled in a weak solution of carbonate of soda; again washed and dried. The grains are then heated with potash or baryta nitrate, dried at a temperature of 90° to 112° Fah. for 12 hours.

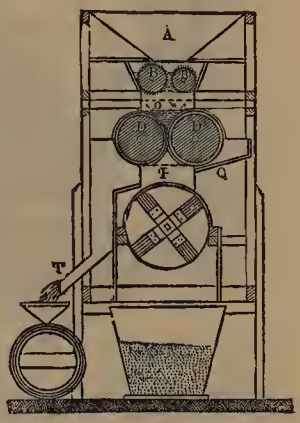
Grape Mill. Figs. 1263, 1264 show Chavanette's (Paris) machine, for crushing, pressing, and de-stalking grapes.

Fig. 1263.



Chavanette's Égrappoir. (Longitudinal Vertical Section.)

Fig. 1264.



Chavanette's Égrappoir. (Transverse Vertical Section.)

It is intended to do the whole duty of crushing the grape, expressing the juice, and removing the stalks, skins, and pips. Great stress is laid upon the perfect separation, on the supposition that the effect of fermentation upon the seeds and stalks is injurious to the wine, and the relative quantity of the skins in the fermentation-vat should be under control, as it is the fermenting skin which confers the color upon the wine. The value of the *dégrappage*, however, is disputed. In the *Côte d' Or*, for instance, it is claimed that the *rafle* (stalk of the huuch) contains the ferment, bitartrate of potassa, and tannin in notable quantities, and its presence in the fermenting vat adds quality to the wine and assists in its conservation.

The machine is driven by hand or by power; in the former case the product is from 80 to 100 gallons per hour, and 8 to 10 times the quantity when driven hy an engine of 1-horse-power.

A is the hopper into which the grapes are thrown. From this they fall hetween two cylinders, *B B'*, the outer surfaces of which have conical-headed nails, which move in close proximity, but without contact. The cylinders are separated by a distance of 5 to 6 millimeters. The crushed mass falls upon a pair of cylinders covered with sheet caoutchouc, which has a uniform thickness of 7 millimeters. The pips, stalks, and skins are drawn through, but deprived of juice, which passes out through perforated plates, *O*, at the ends of the cylinder-box, and then, by the inclined plate *Q* and spout *T*, is discharged into a funnel and barrel. The pips, skins, and stalks drop into a chute, *P*, and then into a long cylindrical horizontal chamber, in which is a revolving helical brush, *F F'*, which drives the contents against the exterior, the lower part of which is covered with wire cloth, while the upper is of wood or sheet metal. The meshes of the portion from *E* to *m* are of such a size as to let the grape seeds fall through; from *m* to *E'* the skins pass out and the stalks are ejected at the end, *n*, of the cylinder. *G*, *H*, *I*, *K*, *L* are gear-wheels for transmitting motion derived from the crank *Z* or pulley *y*. *V* is the fly-wheel.

Fig 1265.

Grape Crusher.

The crushing of the grape is still performed by the feet in many parts of France. Earnest efforts are making to induce the small proprietors to adopt the *écrase-raisin* or *foulóir*.

The grape-crusher, Fig. 1265, of Meixmoron de Dombasle, of Nancy, is a light machine, driven by hand, and placed above the vat. It has two wooden rollers, and rods upon them which act as teeth to draw in and crush the grapes which are thrown into the hopper. The keys allow the juxtaposition of the rollers to be regulated. The work performed is 2,000 kilos of grapes per hour.

The American grape-mill is upon the same principle as that shown in Fig. 1265, a pair of rollers; toothed or spiked, to tear and crush.

The grape mill of Mahille Frères, of Amboise, is shown in Fig. 1266. The teeth on the rollers are spiral, and the action is one of tearing as well as cutting It is the "*usage du Midi*," a great and important grape region.

See WINE PRESS.

Fig. 1266.

Grape Mill.

Graph'ite Bat'te-ry. (*Electricity.*) 1. A term used in England in reference to a battery, having platinized carbon plates and amalgamated zinc plates in dilute sulphuric acid.

2. A battery in which mineral graphite is used as the negative element. See instance in list under GALVANIC BATTERY.

Graph'o-scope. (*Optics.*) A mounted glass for viewing pictures or photographs. The lens mounting is usually hinged to a frame which forms the picture holder.

Fig. 1267.

Graphoscope.

Graph'o-ste're-o-scope. (*Optics.*) A frame with mounted lens, for viewing stereoscopic pictures.

Grap'nel. 1. A boat's anchor with four claws.

2. A grappling hook, for recovering submerged property.

Fig. 1268 shows Toselli's (taupe marine) for directing the search for objects of value at the bottom of the sea. Suspended in the vicinity of the diving-bell is a spring grapple and an electric light with reflector, directing a bright light over a circular area of the bottom. Also used in coral, pearl-oyster, and sponge fishing.

3. A grapple for submarine cables.

The kind of grapnel ordinarily employed in picking up submarine cables for repairs is that known as the *centipede* grapnel. It resembles a compound fish-hook in shape, the stem or shank being set round with several prongs or flukes which catch the cable as the grapnel is dragged across it over the sea bottom. The flukes are rigidly welded to the stem, and one disadvantage in this form of grapnel is its liability to have its flukes broken off if it catches in submarine rocks or other obstructions on the bottom. To prevent the escape of the cable from the claw a fluke has been designed to close upon the cable and prevent its jumping out again.

Jamieson's cable grapnel, shown in Fig. 1269, is self-relieving when it comes in contact with rock or other obstruc-

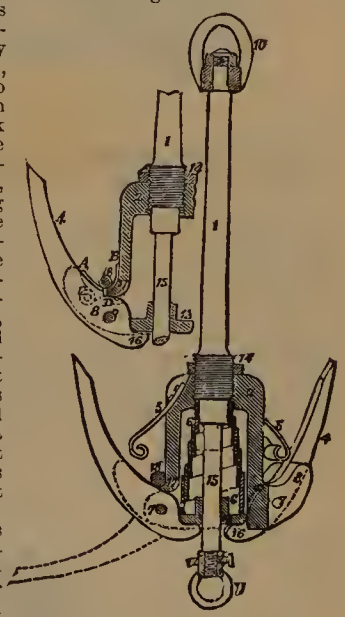
Fig. 1268.

Toselli's (Taupe Marine).

tions on the bottom, and closes on the cable when once encountered.

At the lower end of the grapnel shank, 1, there is fixed a boss, 2, for containing a spring, 6, which exercises a pressure upon the inner ends of the grapnel toes, 4, as the outer portions of the flukes, 8, are called. The toe portion of each fluke is free to move round a center or fulcrum carried by the joint of the fluke, which is rigidly fixed to the boss, so that when the toe encounters a rock or other obstacle of the kind it yields to it, turning round on its fulcrum, 7, and thereby exercising a compression upon the spring until the obstruction is cleared, when the recoil of the spring restores the toe to its former position. When, however, the grapnel meets the cable, the latter, 18, lies in the joint of the fluke, where it is attached to the boss, and it is retained there by a spring, 5, which juts out from the boss and arches over it so as to hold it in.

Fig. 1269



Submarine Cable Grapnel.

The grapnel operates in the following manner: The toes when engaged by rocks or other obstructions are pressed outward and rotate round their respective fulcra, their inner ends bearing against the movable piston 13 on the reduced portion 15, of the shank, which compresses the spring up the boss; a movement which may continue until the toes move round to the angle shown by dotted lines on the left hand, an angle amply sufficient to relieve the toes from the obstruction. As soon as the toes are released, the piston is forced down again by the reaction of the spring, and, bearing against the toes, restores them to their initial working angle. This angle is fixed for each grapnel by the shoulders 17 on the boss 2 which act as stops between the boss and toes, preventing the latter from bending in toward the shank.

The fragmentary view shows a grapnel with an arrangement of cutting shears for severing a cable or torpedo line. In this figure *A* and *B* are two steel knives or shears mounted on respective fulcra, *C* and *D*, and capable of rotating round

them. These knives are ground sharp in their upper edges, on which the cable 18 rests. When a strain is produced on the cable by hauling in the grapnel, these knives shut on each other and shear the cable in two.

The upper shackle 10 is the means of attachment for the grapnel line, and 11 is for the length of chain which is always trailed after a grapnel to keep it from skidding and jumping.

For telegraph cables.

Jamieson & King . . * "*Telegraphic Journal*," vi. 483.
* "*Scientific Amer. Sup.*," 1779.
* "*Engineering*," xxiv. 431.

Submarine cable.

Paper by *Jamieson* . * "*Jour. Soc. Tel. Eng.*," vii. 393.
Lambert . . . . . * "*Jour. Soc. Tel. Eng.*," vii. 417.

Grap'ple. 1. A tool with spring jaws which are closed by striking the fish.

UNITED STATES PATENTS.

7,709	Warner *et al.*
16,014	E. Horton.
20,343	J. Garl.
144,110	J. W. Knapp.
168,335	M. Jincks.

2. A pair of claws grasping a beam or rafter as a means of suspension of a tackle for hoisting hay in a barn, or merchandise in a warehouse. See GRAPPLE, p. 1011, "*Mech. Dict.*"

Grap'ple Dredg'ing Ma-chine'. A dredge with hinged jaws or claws which inclose or clasp the object.

Grap'ple Hay Fork. That form of fork with hinged jaws which mutually approach to clasp the hay; a form of horse hay-fork. Figs. 2027, 2080, p. 907, "*Mech. Dict.*"

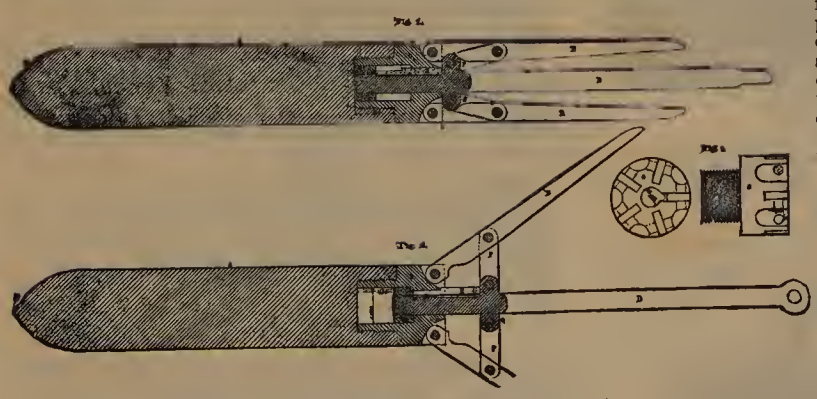
Grap'ple Hook. 1. (*Fishing.*) One with guard to prevent fish from getting loose from the barb. See Fig. 2000, p. 872, "*Mech. Dict.*" Also list of U. S. Patents, 1846–1872; Report of U. S. Fish Commissioners, Part I., 1873.

2. (*Hoisting.*) A pair of hooks to clasp the object to be hoisted. See BALE HOOK, Fig. 181, p. 68; and BARREL HOOK, Fig. 221, p. 78, *supra*; and *c* Fig. 2302, p. 1011, "*Mech. Dict.*"

3. A grapple attached to a beam as a means of suspension of hoisting tackle, etc. See *a*, *b*, *d*, *e*, Fig. 2302, p. 1011, "*Mech. Dict.*"

Grap'ple Shot. A shot used in the life-saving service on the sea-coast. Being fired across a ship, it catches in the rigging and serves as a means of establishing communication with shore. The flukes lie parallel in the barrel, but spring out when the cable is hauled in.

Fig. 1270.



Life-saving Service Grapple Shot. (*Lyle-Emery.*)

Grap'pling Gear. (*Fishing.*) Used to recover lost trawls. See GRAPNEL; GRAPPLE.

Grap'pling Hook. (*Surgical.*) An instrument with a pair of claws at each end, used in post-mortems and dissecting to retain an opened flap in position.

Grap'pling For'ceps. (*Surgical.*) A tweezers with double claws on the end of the prongs. Used in skin-grafting. — *Piffard.*

Grap'pling Tongs. (*Fishing.*) Broad-mouthed tongs for gathering oysters. Oyster tongs.

Grass-burn'ing Stove. A stove for burning prairie grass where coal and wood are scarce.

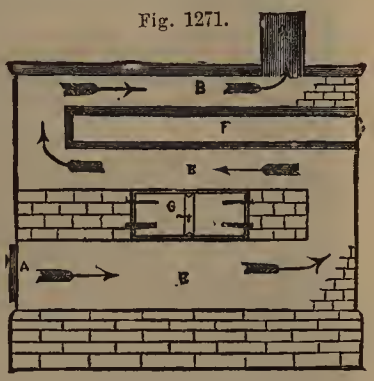
It is built of brick, stone, or concrete.

Grate. 1. An open fire as in the open stove, Fig. 5009, p. 2410, "*Mech. Dict.*"

2. The iron bars containing the fuel in a furnace or fire-box. A collection of grate bars. A grid.

Fig. 1272 shows the Ryder reciprocal grate.

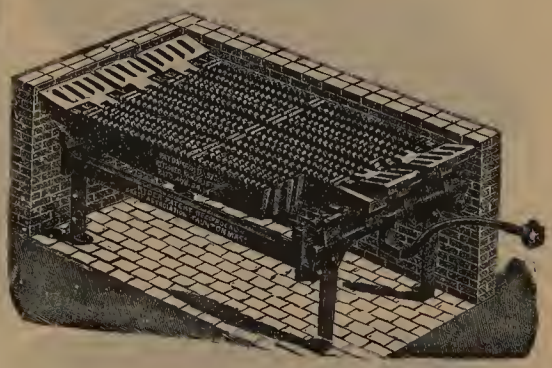
Fig. 1271.



Mennonite Stove.

A. Furnace door to fire-box.
B. Draft.
C. Pipe.
F. Chamber with iron shutter (hinged) to let out heat. This chamber has doors on both sides of furnace.
G. Oven or cooking place on kitchen side of furnace.

Fig. 1272.



Ryder Reciprocal Grate.

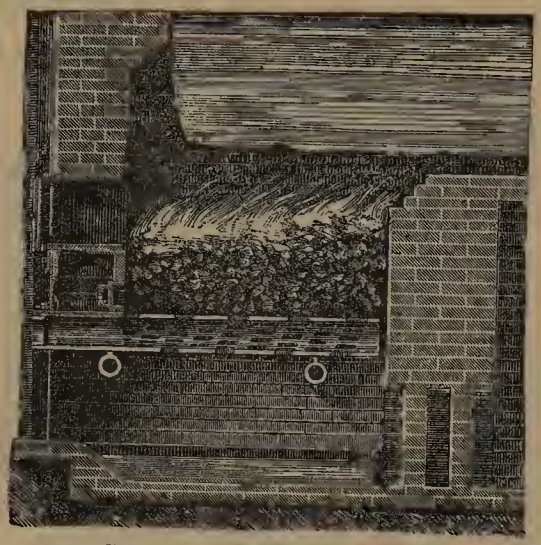
The grate consists of a series of alternate movable and stationary bars. The movable bars are moved backward and forward several inches by a lever in front of the boiler, through the ash-pit door. The movable bars, resting on friction rolls, are raised above the stationary bars a little, and have a corrugated surface for friction, which disturbs the coal, destroys the clinkers, and removes the ashes, thus opening up a uniform draft over the fire surface.

Fig. 1273 shows Schmitz's French furnace, having grate-bars which are hollow to allow passage of air, and turn on their axes to prevent burning out or having clinkers attached to them.

Fig. 1274 shows the Tupper sectional grate for steamboats, locomotives, and furnaces. The sections are laid on truss bars, but not fastened, so that they can expand and contract without strain. The openings in the bars are V-shaped.

Fig. 1275 shows the Hawley-Adams grate. The shaking grate-bars are rocked back and forth by a lever, so as to break up the slag or clinkers which would block them.

Fig. 1273.



Furnace, with Turning Grate-bars.

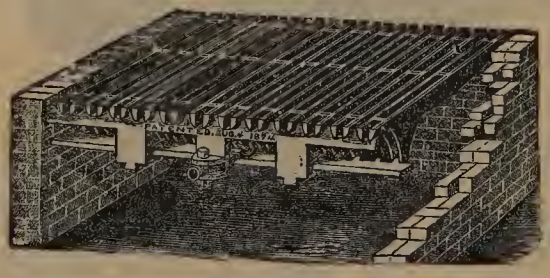
Fig. 1276 shows the grate of the "Calorific" cooking-stove. It has a sliding grate which is

Fig. 1274.

Tupper Grate.

pulled forward to allow the clinkers at the back of the fire to drop out, and the clinkers in front are then picked out.

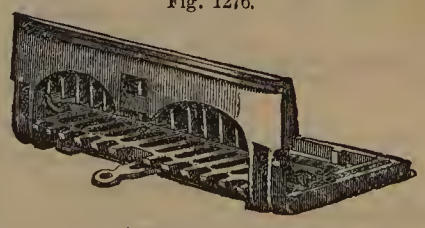
Fig. 1275.



Rocking Grate-bars.

Fig. 1277 is Bissell's radiator shaking grate, the bottom made of a number of parallel bars, which

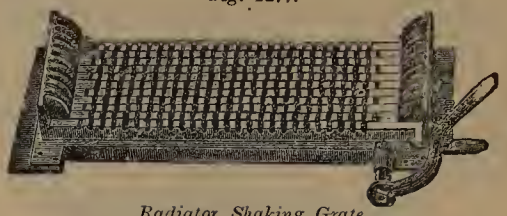
Fig. 1276.



Anti-clinker Stove Grate.

are shaken in concert by means of the handle on the side. Numerous examples are shown under GRATE, GRATE BAR, on pages 1012, 1013, *"Mech. Dict."*

Fig. 1277.



Radiator Shaking Grate.

Refer to: —

Grates at Centennial, shaking.
Rider, Smith, Adams . "*Iron Age*," xviii., Aug. 3, p. 1.
Denny & Ruth . . . * "*Scientific Amer.*," xxxvii. 390.
Erdmans . . . . . * "*Scientific Amer.*," xxxiv. 22.
Peat-burning, Domestic . * "*Engineer*," xlii., 348.
Revolving . . . . . * "*Iron Age*," xviii., Dec. 28, p. 5.
Rotary, *Denny & Ruth* . * "*Min. & Sc. Press*," xxxvi. 177.
Shaking, *M'Farlane* . . * "*Am. Man.*," Mar. 21, 1879, p 8.
Water-bar . . . . . * "*Scientific Amer.*," xxxv 68
Revolving, *Barber*, Engl. * "*Scientific American Sup.*," 855.
Ten Brink, Switz. . . * "*Engineering*," xxviii. 175

Gra'ted Door. A door of open slatted-work for cattle cars in warm weather, and for other purposes.

Grate Ring. A ring surrounding the tip-grate of a heating stove.

Grate Sha'ker. The lever for agitating the grate of a heating stove, to drop the ashes.

Grav'el Pow'der. Coarse gunpowder, otherwise known as pebble powder, which see.

Gra'ving Dock. Clark's elevating dock in the repairing basin of Blackwall, River Thames, is a depositing dock; but instead of depositing the vessels on a grid, as in the Clark & Standfield dock at Nicolaieff, on the Black Sea, the vessel is placed on stocks on a large barge, of the nature of a camel. The lifting is by means of two parallel ranges of hydraulic presses, between which the ship is floated to a position over the cradle and camel on which it is to be lifted, and on which it eventually floats, clear of the water, to be repaired.

A general view of the whole apparatus is given in Plate IX., opp. p. 252, *supra*.

Refer also to —

Birkenhead, Br. . . . . * "*Engineer*," xliv. 152.
Green, Blackwall, Br. . * "*Engineering*," xxvi. 110.
Caisson, Poplar, London . * "*Engineer*," xlvii. 392.
Toulon, Fr. . . . . * "*Engineering*," xxvi. 398, 503.

Grav'i-ty Bat'te-ry. The invention of Callaud or Varley, 1854.

A battery in which the different fluids range themselves at different heights in a single jar by virtue of their differing specific gravities.

The zinc element is above in sulphuric acid, and the copper below in sulphate of copper. The crystals of the latter may be covered with a layer of sawdust or sand, to prevent mixing the fluids by accidental agitation; as in —

Minotto's battery, Prescott's "*Electricity*," p. 60.
Siemens-Halske has interposed paper pulp, Prescott, * p. 52.
See also *Meidinger* . . . * Prescott, p. 53.
Daniell . . . . . * Prescott, p. 59.
Sir William Thomson . * Prescott, p. 62.
Ubicini . . . . . "*Telegraphic Journal*," v. 265.

See also CALLAUD BATTERY; GRAVITY BATTERY, "*Mech. Dict.*"

Grav'i-ty In'di-ca'tor. An invention by M. Lebourg, for experimental verification of the laws of falling bodies.

"A flattened cylindrico-conical weight, guided in its fall, like that of General Morin's apparatus, carries, instead of a style, a vertical tuning-fork, furnished with a short and stiff metallic wire. The weight falls down a rule, graduated on one of its edges, and covered with smoke black. The tuning-fork is set in vibration automatically at the commencement of its fall, and it inscribes on the fixed rule a sinuous line, inspection of which affords an easy demonstration of the

laws of the fall of bodies. By mounting on the apparatus several tuning-forks one may compare together their number of vibrations, and even determine the absolute height of the sound produced." — "*Journal de Physique.*"

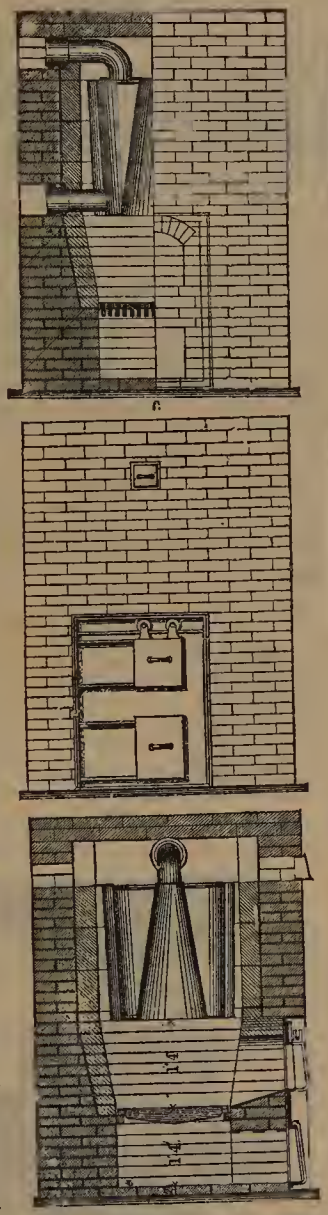
Grease Box. The axle-box of a railway truck.

Grease cup, automatic, Fr. * "*Sc. American*," xxxiv. 230.

Greas'er. A name for oil-cup, lubricator, oiler, etc. See under the various heads.

Grease Trap. A cistern in the course of a sewer. An inlet pipe discharges into the cistern, and the orifice of the outlet is a bent pipe so far beneath the surface as to avoid removal of the floating scum of grease. — *Waring's "Sanitary Drainage."*

Fig. 1278.



Greenhouse Furnace and Boiler.

Green'house Furnace. The boiler for hot water heating apparatus for conservatories is usually a ribbed or corrugated iron, or sectional ring boiler, set in brick-work, and having departure and return pipes in which the water circulates through the greenhouse.

Burbidge & Healy's greenhouse heater is shown in Fig. 1278; three views, a combined half-vertical section, and half-front view; a front view and a transverse vertical section. The bells for the attachment of the pipes are shown on the left in the upper of the three views.

"*Scientific American Sup.*," 2250, 2394.

Green'house Syr'inge. A hand irrigator. See AQUAPULT; HAND PUMP; IRRIGATOR, etc.

Green'house Ven'ti-la'tor. A window-lifting apparatus for the glazed roofs of conservatories.

Green Ware. (*Ceramics.*) Articles just molded or otherwise shaped, before drying and baking.

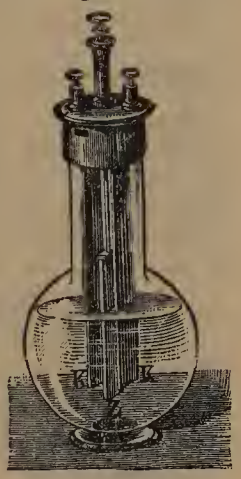
Gre-nade'. The modern hand-torpedo, used in the British navy, is a compressed ball of gun-cotton, attached to a long cord, by means of which the torpedo is exploded with a force sufficient to shatter a five-ton block of granite when it has been pitched into position.

Gren'a-dine. (*Fabric.*) A French worsted dress-goods, woven with a gauze or open taffeta armure, and having a silk *grège*, organzine or cotton warp and an English combing-wool weft, which is highly twisted and gas-singed.

It is a kind of close barége.

Gre-net' Bat'te-ry. (*Electricity.*) A single-fluid bichromate battery. A bottle-shaped vessel has a stopper from which two carbon-plates depend into the liquid. A zinc plate, *Z*, between the carbons *K K*, by means of a rod passing through a central aperture in the stopper, can be immersed at will in the liquid, to set the battery in action.

Fig. 1279.



Grenet Battery.

Niaudet, Amer. transl., * 222. Trouvé's improvement on Grenet compounds a number of pairs of removable elements. *Niaudet, ut supra*, * 224.

Grid. 1. A grate, grate-bar, or furnace bottom.

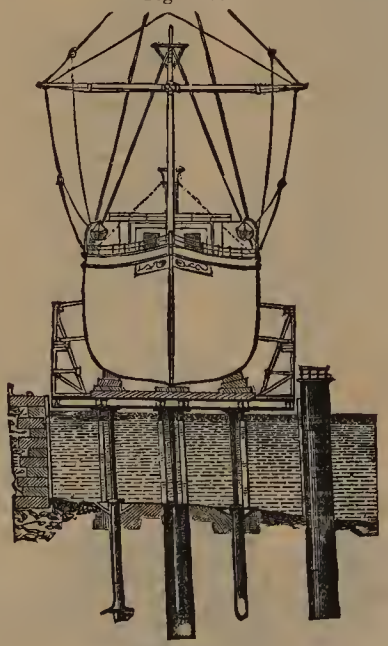
2. A grille or grated opening.

3. (*Hydr. Eng.*) A structure of beams — lying in parallel open order they resemble a gridiron — on which a ship rests in building, lifting, or repairing.

Fig. 1280 shows a hydraulic grid of Clark, Standfield, & Co., whose depositing dock is a grid of the largest and most admirable construction, and is shown in Plate IX., DEPOSITING DOCK, *supra*.

In using the dock the grid and presses are lowered to the bottom, and the keel of the vessel is brought directly over

Fig. 1280.



Hydraulic Grid.

the center and secured in position by the bilge blocks and side shoring frames, the presses are then worked and the vessel lifted till the grid is above high-water mark. When in this position a number of struts or swinging frames (which were previously held up in a horizontal position under the grid) are liberated and allowed to hang in a vertical position. The grid is now lowered a few inches until the whole of these struts rest on raised bearings cast on the head of the presses, and the whole weight of the vessel and grid rests on them. The rams are now allowed to sink down into the presses, where they remain in fresh water, and are consequently less disposed to rust. The supports are hinged or swung at the top so as to fall accurately into their places, and suitable means are provided for raising and lowering them simultaneously by means of chains and shears. These frames are of considerable breadth, and some of them swing transversely and others longitudinally, so as to obviate any tendency of the grid to move in either direction. There are also, in addition, strong cast-iron columns, with guides,

against which the grid slides as it rises and falls. The pumps, pipes, and valves are similar to those used in ordinary hydraulic docks.

See also HYDRAULIC HOIST, *infra.*

Hydraulic.

Clark & Standfield, Br. . . * "*Engineering*," xxvii. 203.
* "*Scientific Amer.*," xl. 291.

Grille. A panel of metal open-work in a wall.

Grind'er. 1. (*Caoutchouc Manufacture.*) A pair of large iron rolls revolving at a moderate speed, between which the rubber with the sulphur and other substances to be mixed with it are repeatedly passed and ground together until they are thoroughly combined, and form one homogeneous mass of about the consistence of ordinary putty.

2. A machine for sharpening, as a grindstone or emery wheel: which see.

3. A machine for dressing to form, using abrading materials as a substitute for a planer, etc. See GRINDING MACHINE.

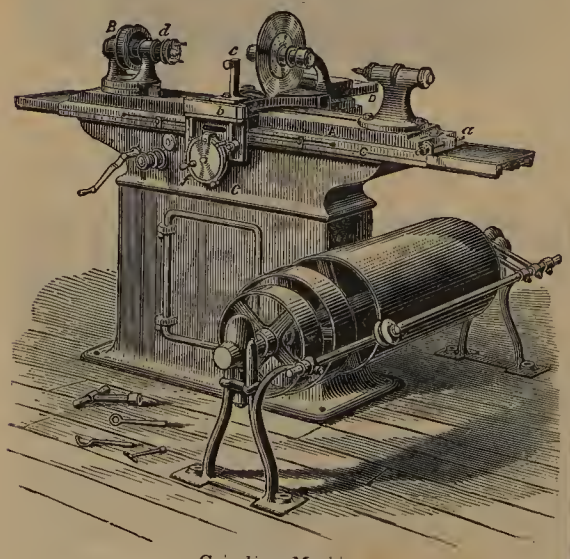
Grind'ing and Pol'ish-ing Tools, etc. See under the following heads: —

Agate burnisher.	Furrowing machine.
Buhr dresser.	Knife cleaner.
Buhr rubber.	Knife grinding machine.
Bur.	Mill-file.
Burnisher.	Millstone dresser.
Burring engine.	Pillar-file.
Cabinet file.	Plug-finishing file.
Cherry.	Polisher.
Corundum point.	Polishing disk.
Corundum tool.	Polishing iron.
Cross file.	Porte polisher.
Dental file.	Rasp.
Dental grindstone.	Reaper.
Dental polisher.	Riffler.
Double ender.	Round iron.
Emery band.	Saw filing clamp.
Emery board.	Saw filing vise.
Emery stick.	Scraper.
Emery stone.	Scraper plane.
Facing tool.	Scratch brush.
File.	Scratcher.
File-card.	Shave hook.
File carrier.	Six-canted file.
File guard.	Tripoli.
File holder.	Tube brush.
Finger steel.	Tube cleaner.
Five cant file.	Tube scraper.
Float.	Veneer scraper.
Furrow rubber.	Wall scraper.

Grind'ing Lap. A grinding machine with a revolving wheel for cutting surfaces. See LAP, p. 1252, "*Mech. Dict.*"

Grind'ing Ma-chine'. A machine adapted for the execution of circular grinding, such as the grinding of hardened plugs, arbors, spindles, reamers, standards, cutters, etc. It will grind straight and tapering, either inside or outside, and is especially useful in grinding out holes in hardened cast-steel boxes and bushings.

Fig. 1281.



Grinding Machine.

Brown & Sharpe's grinding machine, Fig. 1281, operates by a solid emery or corundum wheel. The work can be revolved upon dead centers or otherwise. The grinding wheel can be moved over the work at any angle, by which means any taper can be produced. Wheels from $\frac{1}{4}''$ to 12″ in diameter can be used either with or without water. The feed-works and slides of the machine are protected from grit and dust. The grinding of taper holes and angular cutters is provided for by graduated arcs. A special chuck is provided, for holding work to have holes ground. An additional movable table, capable of adjustment by a tangent screw and graduated arc, admits of straight and curved taper grinding with the centers of the machine always in line.

Refer to: Ventilators for, Br. * "*Eng'ing*," xxii. 19, 169.
Lathe, *Pratt & Whitney* . . . * "*Engineer*," xlii. 24.
Machine, metal, *Bollmann*, Fr. * "*Sc. Amer.*," xxxvii. 214.
* "*Iron Age*," xxi., May 2, 1
Tools, On grinding, *Rose* . . * "*Sc. Amer.*," xxxvii. 405
Universal, *Thompson, Sterne & Co.*, Br.
* "*Engineer*," xli. 187.

Grind'ing Mill. The subject is considered under many heads assembled in list under GRAIN CLEANING AND GRINDING, p. 411, *supra.*

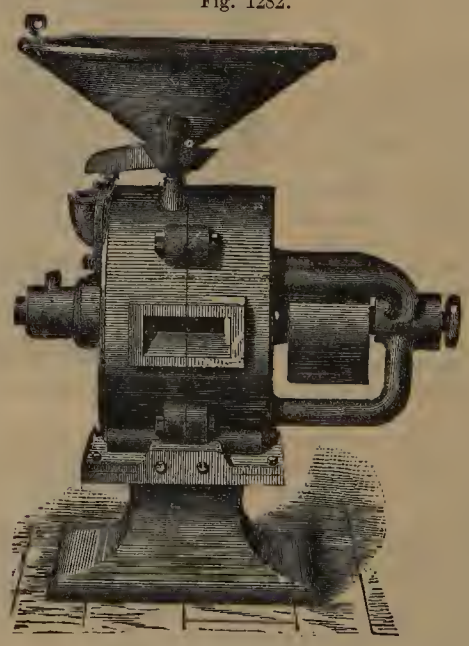
The purposes and construction of machines differ greatly; they are adapted for grain, ore, fertilizers; are made vertical or horizontal; edge rolling (Chilian); grinding on the flat; upper, under, or both stones moving; made of iron, buhr, glass, etc.; are made like cages, working by impact; grind by a tearing action between two surfaces, or a crushing between a roller and concave, or flattening between two rollers, etc. See numerous examples of forms and principles, Plate XXII., "*Mech. Dict.*," opp. p. 1020.

The principal heads under which they will be found are:

Aplatisseur.	Corn mill.
Aspirator.	Cylinder mill.
Bean mill.	Fertilizer mill.
Bone mill.	Granulating mill.
Cake grinder.	Kibbler.
Cement mill.	Ore mill.
Concasseur	Roller mill.

See also list under MILLS, *infra.*

Fig. 1282.



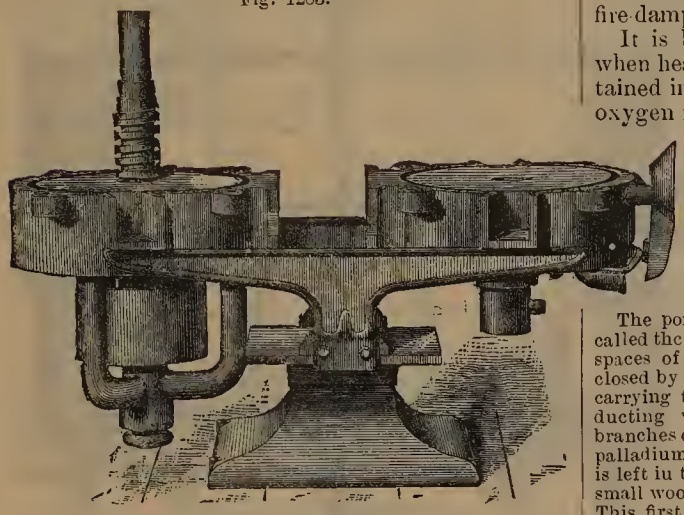
Grinding Mill. (*Elevation.*)

Figs. 1282, 1283, show the Harrison portable mill with a pair of stones, one being a runner.

Fig. 1282 is an end or face view. The case and pedestal are cast in one piece. The heads containiug the bed aud runners are bolted to the rim of the case.

Fig. 1283 shows the pedestal and case, with a dressing-frame bolted on and the buhrs turned out upon it for dressing. The frame is made in two parts, and fastened, oue on each side of the case, by tap bolts, and when the dressing is done the frame is removed.

Fig. 1283.



Grinding Mill. (*Open for Dress.*)

Refer to: —

Bressen & Co., Fr.	* "*Scientific American*," xli. 243.
Buhr	* "*Scientific American*," xl. 178.
Portable, *Clayton & Shuttleworth*, Engl.	* "*Scientific American*," xli. 70. * "*Engineer*," xlvii. 423.
Harrison	* "*Scientific Amer.*," xxxvii. 291, 310, 323.
Munson	* "*Scientific American*," xli. 54.
Nicholson	* "*Engineer*," xlvii. 408.
Obenchain	* "*American Miller*," vii. 239.
Iron upright, *Phillips*	* "*Scientific Amer.*," xxxviii. 328.
Ransomes	* "*Engineer*," xlvi. 403
Ross	* "*Scientific Amer.*," xxxvii 339
Walling	* "*Scientific American*," xli. 83.
Upright, *Straub*	* "*Scientific Amer.*," xxxvi. 86. * "*Scientific American*," xl. 34.
For gunpowder, Br.	* "*Engineering*," xxv. 37.
See also GRAIN MILL.	
Both stones running	* "*Scientific Amer.*," xxxiv 35.
Corn Mill, *Ransome*, Br.	* "*Engineering*," xxvii. 319.
Garlic extractor, *Millot*, Switz.	* "*Engineer*," xlvi. 255
Floating mills, *Balaklava*	"*American Miller*," vi. 101.

Dr. Kuight's report on agricultural machinery at the Paris Exposition of 1878 contains views and descriptions of the following feed mills. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 200–205: —

Grain flattener. *Bodin*, France.
Grain crusher, *Richmond & Chandler*, England.
Biddell's oats and beans kibbler. *Maldon Iron Works*, England.
Oil-cake breaker. *Corbett & Peale*, England.
Consult: *Hughes'* "*American Miller and Millwright's Assistant.*"
Dixon's "*Practical Millwrights' & Engineers' Guide.*"
Pallett's "*Millers', Millwrights' & Engineers' Guide.*"

Grind'ing Wheels. Grinding wheels are known as stones, laps, glazers, rubbers, etc., according to material, fineness, etc. Including the finer ones which are *polishing* wheels, they are made of stone, emery solidified by cement, wood, leather, paper, lead, rags (cut in disks), brush.

For the materials for arming the surface, see GRINDING AND POLISHING MATERIALS, p. 1017, "*Mech. Dict.*"

Grind'stone.

J. M. Safford's report in "*Centennial Exhibition Reports*," Group I., vol. iii., p. 183, *et seq.*

Grinding wheels, on, *Rose* . * "*Scientific Amer. Sup.*," 540.
Making and uses, *Mitchell* . * "*Iron Age*," xviii., July 6, p. 9; July 20, p 7.
Trough, *Brown & Sharpe* . * "*Sc. American*," xxxviii. 271.

Grind'stone Dres'ser. See TRUEING TOOL, Fig. 6682, p. 2632, "*Mech. Dict.*"

Gris-aille'. (*Fabric.*) A French fancy dress goods woven on a taffeta loom. It has a cotton chappe or fancy warp and an English combing wool weft. Warp is printed or *chiné*.

Gri-sou'me-ter. (Fr. *grisou*, fire-damp.) A fire-damp detector invented by M. Coquillon.

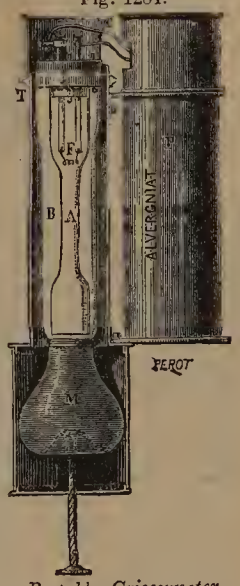
It is based on the property of palladium wire when heated, to burn the last traces of hydrogen contained in any carburet when supplied with sufficient oxygen for its combustion.

The reduction in volume resulting from this combustion is proportionate to the quantity of the protocarburet, so that a properly graduated gage furnishes at once the proportion of gas consumed.

The same principle is found in Coquillon's *Carburometer*.

The portable grisoumeter consists of a central tube, *A*, called the burner, narrowed in the middle and graduated into spaces of equal capacity; the lower end is open, the top closed by an india-rubber stopper carrying two holders for the conducting wires, and the lower branches of which press down the palladium wire. A third opening is left in the stopper to receive a small wooden plug or a glass rod. This first tube is surrounded by a glass sheath or cylinder, *B*, closed at the top by a rubber disk having an orifice which closes by means of a plug. To the lower portion is adapted a diaphragm containing water, which is elevated or depressed by means of a screw, on the principle of the Fortin barometer. Next to this first portion of the instrument is placed a second one, which consists of a Plante's condenser, the poles of which are attached to the two holders of the burner. A lateral screw acting by pressure starts the current and heats the wire at the desired moment. When an analysis is to be made, the inner tubes being full of water, the screw is lowered, so that as the liquid descends it is replaced by the air of the mine. The volume is so adjusted that the levels of both the tube and sheath are on the same horizontal line opposite the zero of the scale.

Fig. 1284.



Portable Grisoumeter.

The burner is now closed while the outer sheath is left open. The electric current is started and the wire heated to redness The gas is rapidly burned, and after giving time for cooling, the water is seen to rise more or less in accordance with the quantity of gas burned. The two water levels are readjusted by means of the bottom screw to equalize the pressure; and the division of the scale opposite the surface level read off. This instrument gives in one reading the amount of protocarburet in hundredths, but does not apply to quantities of the same exceeding five to six per cent. This would be useless practically, as at this point the miner's lamp is full of fire and he himself in the midst of a detonating compound.

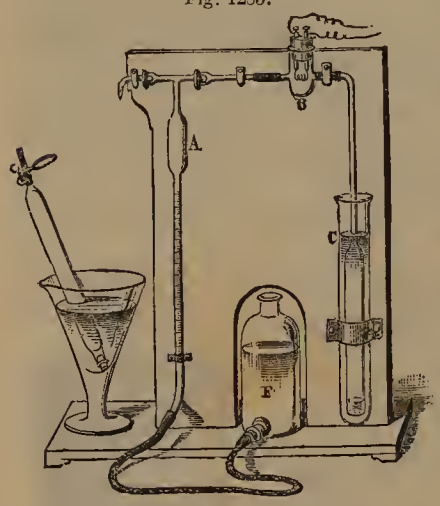
M. Coquillon has since replaced the palladium by platinum.

The principle of the stationary grisoumeter is based on Professor Deville's double flask, and is shown in Fig. 1285. It comprises, first, a vertical glass tube, *A*, or gage, the top of which is branched in T shape, two cocks being adapted to the horizontal branches of the T. The lower portion of this tube is constricted and carries ten divisions, each of which may be subdivided into ten others; it is bent at right angles and attached to a rubber tube fastened to a flask used as an aspirator or blower. The capacity of the tube measured from the cock is 25 cubic centimeters, and the zero of the scale is indicated at the bottom. This is the point that must be reached by the gaseous volume when no protocarburet is contained in the instrument; 10 is marked near the bulge, each division being equal to ½ cubic centimeter. The second portion of the apparatus is the burner *B*, formed by a small thimble-shaped tube closed by a rubber stopper pierced by two holes into which are introduced the holders for the palladium wires.

laterally are adapted small capillary tubes which by means of rubber tubing allow of an attachment on the one side to the gage, on the other to the following bell glass. This last, *C*, is capped by a capillary tube bent at right angles and surrounded by a glass cylinder or sheath closed at the bottom and filled with water. The whole apparatus, as well as the corks, is in glass, and is mounted on a stout wooden board so as to protect it from accident. A small box containing 10 small tubes filled with water is accessory to the apparatus, these being filled when desired with the air collected in the various levels of the colliery and destined for analysis.

The use of the stationary grisoumeter is very simple. The bell glass surrounded by its cyliuder is filled with water to a

Fig. 1285.



Stationary Grisoumeter.

determinate or fixed point: the gage tube is also filled with water. The burner and capillary tubes are left full of air. One of the small tubes from the box is now attached in such a manner that one end plunges into a tumbler full of water while the other or taper end is connected by means of a rubber tube to the anterior end of the gage. One of Mohr's forceps closes this rubber tube at the desired height

In order to introduce 56 centimeters of gas into the gage, the left cock is opened and the forceps pressed by the right hand, while the left hand holds the flask so as to be able to raise or lower it at will. The gas passes from the conico-cylindrical tube into the gage, and must be made to coincide with the zero of the scale as indicated by the water level. This being done, the left cock is closed and the right opened, and at the same time the palladium wire is heated to redness. The gas is made to circulate two or three times over the palladium by the motion given to the flask. After the burner has cooled down, the gas is returned to the gage, and the scale read off. This last is so graduated as to indicate at sight hundredths and thousandths of protocarburet or of bicarburet.

Portative, *Coquillon* . . . . "*Technologiste*," xl. 435.
Rignard . . . . . "*Technologiste*," xxxix. 375
Lamp, *Mallard et al.* . . . . "*Technologiste*," xli. 348.
Dissipating fire-damp, *Delaurier* "*Technologiste*," xli. 647.
Coquillon . . . . * "*Engineering*," xxiv. 317.
* "*Manuf. & Builder*," xi. 158.
* "*Engineer*," xlix. 53.

See also PHANARO-GRISOUMETER, *infra*. FIRE DAMP DETECTOR, *supra*, and references *passim*.

Grist Tol'ler. This machine operates through the periodical presentation of a toll spout with its attendant valve. Each time the spout is presented under the falling grain it takes in a portion which is carried down and out of the machine as toll.

The amount of toll taken is governed by a device in which the position of a wrist in a slotted crank regulates the amount taken.

Grits. (*Milling.*) Cracked fragments of wheat smaller than *groats*. An incident to the HIGH MILLING process, which see. See also GROATS.

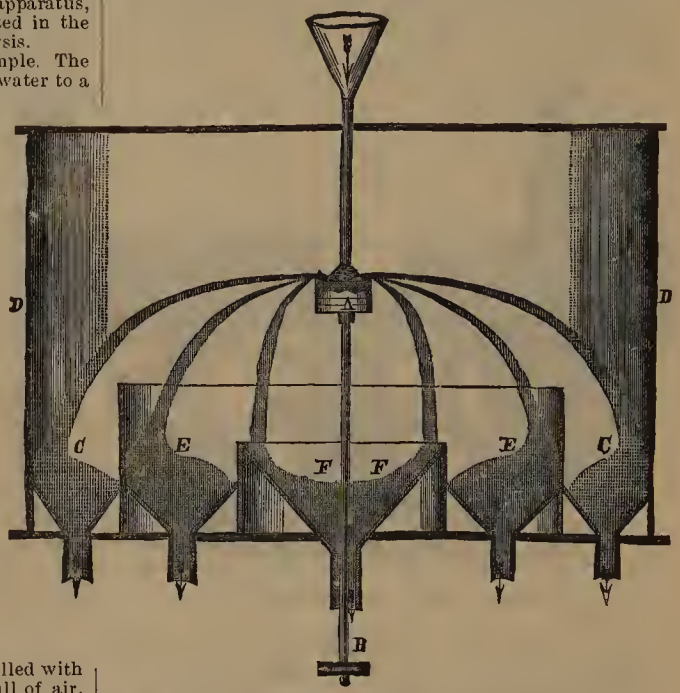
Grits Gra'ding Ma-chine'. (*Milling.*) A centrifugal apparatus for grading grits after the separation of the fine flour by the process of bolting.

The grits passes by a spout to the top of a rapidly revolving wheel, *A*, and is projected centrifugally; the larger particles fly to a greater distance and fall at *C*, while the others reach *E F* respectively, according to relative levity.

Grits Mill. The grits mill with one cylinder is used in the St. Georgen manufactory of St. Gallen.

W is the cylinder with steel shell and *S* the steel concave. It is used for the cracking of wheat and the production of grits, leaving further milling to be done with a run of stones.

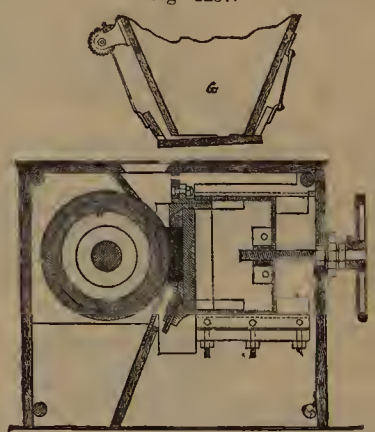
Fig. 1286.



Grits Grading Machine.

Grits Pu'ri-fi'er. A machine for separating bran scales from grits. It is of Austrian origin, the originator being Ignaz Paur, the inventor of

Fig. 1287.



Cylinder Mill of St. Georgen, St. Gallen, Switzerland.

the high-milling process. Paur's and Escher Wys's grits-purifiers are shown by Kick in his report on Group IV. to the Austrian Government, 1873, and in Prof. Horsford's report, "Vienna Bread," Vienna Exposition, 1873, vol. ii., § B.

The machine, Fig. 1288, acts by a blast of air upon the materials of different gravity.

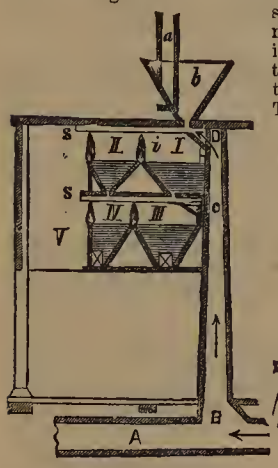
The *bran* is a thin flat scale of the wheat shell. The grits are irregular fragments from the interior of the grain, relatively heavier than the bran.

a is a supply tube introducing the mixed bran and grits. *b* is a hopper with a slit at the bottom. At *D* a current of air enters and encounters the falling stream of bran and grits. The grits being heavier fall into division *I*, the bran is carried to *V*, and the intermediates fall into *I I*. A sec-

ond current of air entering at *c* subjects the matters to a farther separation.

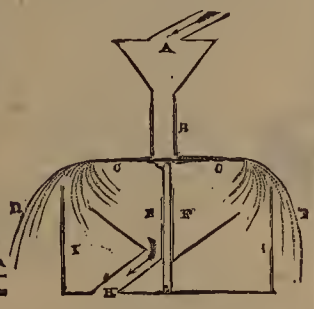
Another form is shown in Fig. 1289, and is used at Pesth. *A* is a hopper receiving the meal; *B* a cylinder fitting the spout from the hopper, and admitting of raising and lowering; *b* is a circular smooth metallic plate revolved by a vertical shaft attached below. The meal as it issues from the

Fig. 1288.



Paur's Grits Purifier.

Fig. 1289.



Grits Purifier. (Pesth.)

foot of the hollow cylinder is carried to the periphery and shot outward into the current of air produced by suction through spout *H*. The rounded grits, having greater weight in proportion to the extent of surface, reach the space *D*; the bran-flakes, having least material to surface, are drawn to *F*; and the fine flour falls between to the receptacle *H*.

Griz'zly. (*Cal. Hydraulic Mining.*) *Grizzlies* are heavy iron grates which catch the bowlders and through which the gravel is sifted; they are placed at the point where the washings fall into the sluice.

Groats. (*Milling.*) *a.* Bruised or cracked fragments of wheat with bran attached; larger than *grits*. An incident to the process of HIGH MILLING, which see. This is the technical meaning of the word; adopted in the search for specific words to indicate conditions of fineness or quality.

b. Hulled and broken grain, used as an article of food. May be of wheat or oats. This is the domestic meaning of the word *groats* (pr. *grits*).

Groom'er. An application of the flexible or

Fig. 1290.

Horse Groomer.

jointed revolving shaft to rotate a brush used in the grooming of horses. The flexible shaft is thus used in drilling, by dentists, for sheep shearing, horse clipping, hair cutting and brushing, and horse grooming.

Fig. 1291.

Groover Head.

Groov'er Head. A circular cutter used on a wood-planing machine to cut the grooves on one edge of matched boards. The cutters have spurs, and are held in slots by tapered compression bolts.

Groov'ing Ma-chine'. A form of lathe for making grooved or scroll work, such as table legs, balustrades, etc.

Ground Cock. A basin cock, ground into its seat, as distinguished from *compression* cock.

See Fig. 672, p. 216, *supra*.

Ground'ing Ma-chine'. (*Wall Paper.*) A machine for giving the requisite body to receive the colored pattern.

While passing over a roller the paper is covered with a mixture of clay (that used contains about 18 per cent. of alumina), glue, and water, and if the surface is to be finally polished — or satin finished — a percentage of lard oil is added. After the mixture is applied it is evenly distributed over the paper, first by two reciprocating brushes, then by a rotating brush roller, and lastly by two brushes like the first.

See cut, Fig. 1, p. 226, "*Scientific American*," vol. xxxvii.

Group Spring. *Railway.* One formed of a number of separate springs in a cluster. See *u*, Fig. 1143, "*Mech. Dict.*"

Grous'er. (*Hydraulic Engineering.*) A heavy iron-pointed oak timber which passes through the hull or down the side of a boat for the purpose of anchoring.

"*Report of Chief of Engineers*," 1876, vol. ii., Part II., p. 403, and A, Fig. 1.

Grout Wall. One made of béton or similar material.

"Grout (or concrete) as building material, is composed of lime and coarse gravel mixed with water, in the same manner as ordinary mortar, and of about the same consistency

"A small proportion of cement — say, one tenth — may be mixed with lime, and will add to the strength, durability, and finish of the walls.

"To give solidity, quarry chips can be used by being imbedded in the composition while forming the walls.

"The walls of buildings are formed of this material by making boxes or molds of 2″ plank, of uniform width, placed on edge horizontally, as wide apart as the desired thickness of the walls, and held in place by cleats. Into these boxes or molds thus formed the grout is put, and allowed to remain a sufficient time to harden; when the boxes are removed, and again placed at the top of the layer just formed, and again filled with gravel and stone; and so on until the wall is of the required height.

"If the planks of which the boxes are made are, say, 12″ wide, the grout will harden in about 24 hours sufficiently to allow the boxes to be removed without injury to the wall.

"The gravel used may be mixed with a moderate proportion of sand advantageously.

"The partition walls can be built more cheaply and rapidly of lumber than of gravel; as where inside walls are constructed it is difficult to fit and manage the boxes without injuring the outside walls."

The boxes and method of construction are similar to those used in pisé walls. The difference is only in the material used. — *Report of Lieut. Rogers, U. S. A.*

Grove Bat'te-ry. The nitric acid battery, the invention of Mr. Grove, now Justice Sir W. R. Grove. It eliminates the hydrogen by oxidizing it so as to form water, and so prevents the polarization of the negative plate.

It has the amalgamated zinc in sulphuric acid, and its platinum in nitric acid, with an intervening porous cell.

Prescott, "*Electricity*"	* 64; *Ganot*, * 686.
De la Rive, London, 1853	* 44.
Noad, London, 1859	* 276.
de Moncel, Paris, 1856	69.
Shaffner, New York, 1859	* 97.
Niaudet, American transl.	* 155.
"*English Mechanic*"	* xxiii. 77.
Poggendorf's modification, *Niaudet*, American transl.	* 155.

Grow'ing Cell. (*Optics.*) Beck's. A plate of glass into which is fitted an annular zinc trough upon the upper surface of which a cover of plate-glass is screwed. On the top of this glass the object to be kept alive is placed, and over it is laid a thin glass cover.

The action of this growing cell is as follows: The trough

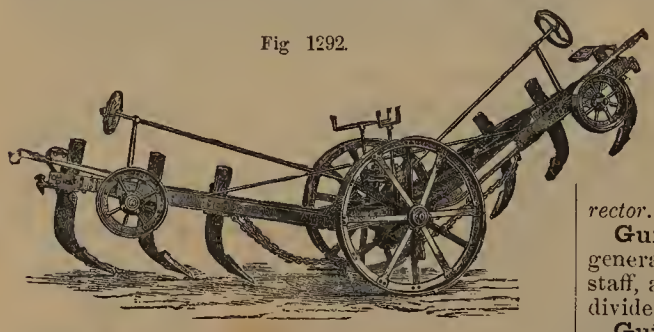
is filled with water, the plate-glass is screwed down, the thin cover placed upon it. The plate-glass cover has two holes pierced in it, one of which comes under the covering glass, and through which the water will flow by capillary attraction, feeding the object. The other hole is outside and will admit sufficient air to replace that lost by the capillary action under the covering glass.

Grub'ber. An implement for deep cultivation.

An implement for tearing through soils infested with grubs, stumps, stones, and roots. A clearing plow.

The steam grubber, Fig. 1292, is one of the set of steam cultivation implements. It is especially intended for working in stiff clay land, to stir and aërate the subsoil without

Fig 1292.



Fowler's Steam Grubber.

materially disturbing the surface. For this purpose it is made with 1, 2, or 3 tines, and is worked 2′ deep. It is also used for stirring up the subsoil of old grass lands, and, with 1 or 2 tines, to a depth of as much as 30″ in removing stones or tree-roots. It is known as a "knifer."

It may be called a renovating or reclaiming implement, and under all circumstances of its use is a powerful assistant in the matter of drainage in strong soils.

Grub'bing Ma-chine'. A special gun-tool. The work has a semi-rotary motion against a fixed tool.

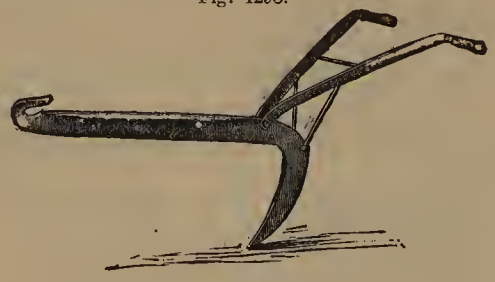
In the special grubbing machine the tool has a motion on a segment of a circle, and an automatic feed. — *Pratt & Whitney.*

Grub Break'er. (*Agric.*) A form of heavy plow used in recently cleared land, and having a strongly braced colter and share for uprooting grubs and breaking roots.

Grub Hoe. An implement something between a hoe and an adze, used in cutting and digging up brush, saplings, etc.

Grub Hook. An implement drawn by a team and used in rolling out stones and tearing out roots, stumps, and logs.

Fig. 1293.



Grub Hook.

Grum'met. (*Nautical.*) See GROMMET, p. 1025, "*Mech. Dict.*"

Guard. A fence, fender, screen, canopy, etc., as the case may be: —

A dash-board, or step-guard in cars.

A fender in grates.

A piece to receive the jar of an opening door.

A screen to keep the heat of a fire from a person, wall, or furniture.

A grating to a window to preserve it from blows.

(*Fire-arms.*) The bow which protects the trigger.

Guard Bolt. A flat-headed screw-bolt, fully counter-sunk, for fastening the guards of mowing machines to the bars.

Guard'ed In'stru-ment. (*Surgical.*) Said of an instrument the point or cutting edge of which is concealed or guarded during introduction, and uncovered when at the place where it is to become effective. As *guarded blunt-hook, guarded bistoury, guarded trephine.*

Bistoury caché expresses the same idea.

Gui'bal Fan. A ventilating wheel on the exhaust principle, receiving the air around its axis and forcing it by wings centrifugally to the exit shaft.

Guide. (*Surgical.*) A stiffening stem, withdrawable, in a soft rubber catheter.

A cannulated stem affording a means of direction to a flexible instrument. A *director.*

Gui'don. The flag of a commander of horse; generally of damask and fringed, 3′ broad on the staff, and lessening towards the bottom, where it is divided into two peaks.

Guil'lo-tine In'stru-ment. (*Surgical.*) An instrument for excising the tonsil or uvula. It has a cutter sliding in guides and a loop to hold the object.

See TONSILOTOME, *e*, Fig. 6525, "*Mech. Dict.*"; UVULATOME, *d*, Fig. 6886, *Ibid.*

Home-made . . . . * "*Scientific American*," xlii. 295.

Gui-tar'. (*Music.*) An instrument played by the hands, having 6 strings tuned in fourths and thirds. The three lower strings are of silk, covered with silver wire; the three upper of catgut. The three former are usually played by the thumb; the three latter, G, B, E, by the fore, middle, and third fingers respectively, the little finger resting on the instrument.

Gum De-pres'sor. A dentist's tool, used in holding the gum down from the tooth in filling cavities close to or under the gum.

Gum Lan'cet. (*Surgical.*) A pocket lancet in shell handle. See *a*, Fig. 2795, p. 1249, "*Mech. Dict.*"

Gum'mer. A tooth for gulleting saws. See SAW GUMMER.

Gum'mer Grind'er. A tool for holding the cutter of a saw gummer while being ground.

Gum Spring. One made of caoutchouc — india rubber.

Gun. See CANNON; RIFLE, etc.

"Duilio," *Armstrong* gun.

Bore	17.72″.
Shot	2018 lbs.
Maximum charge powder	511 lbs.
Ordinary charge powder	355 lbs.

See CANNON, RIFLE, etc., and various specific heads.

Sporting and whaling guns.	*Gatling* gun.
Blow-gun.	*Armstrong* gun.
Syringe gun.	*Whitworth* gun.

Rifle-barrel in shot-gun bore.
Stevens . . . . . * "*Scientific American*," xl. 263.
Gun-lock concealed.
" Climax," *Holland* . * "*Scientific American*," xli. 411.
Gun tool, *Barthel* . . . * "*Scientific American*," xl. 131.
Hammerless, *Guener*, Br. * "*Scientific American*," xliii. 274.

Gun Bar'row. The *brouette militaire* of M. Bazin. The butts of two rifles are attached to a pair of small wheels; the barrels form handles; the barrow supports the soldiers' knapsacks and other impedimenta.

Gun'boat.

Gunboats ready for launching, Portsmouth, Eng. * "*Scientific American Sup.*," 2034.
Chinese . . . . . "*Scientific American Sup.*," 983.
"Delta," China . . . * "*Scientific American Sup.*," 1087.
"Epsilon," China . . * "*Engineer*," xlviii. 144.

Gun Brush. A spiral cylindrical brush with stiff bristles; used for cleaning gun-bores.

Gun Car'riage.

The "*Report of the Chief of Ordnance, U. S. A.*," 1877, Appendix K, contains notices and views of the following:—

Austrian field carriage . . .	Plate IV.
Austrian 3.42″ gun and caisson	Plate V.
English 9-pounder field carriage	Plates VI., VII.
German field carriage	Plate VIII.
Engelhardt's field carriage . .	Plate IX.
Swedish field carriage	Plate X.
Swedish traveling forge . . .	Plate XI.
English field traveling forge . .	Plate XII.
English 7-pdr. mount'n carriage	Plate XIII.
Gruson's 21-pdr. coast carriage .	Plate XIV.
Krupp's 12″ gun and carriage .	Plate XV.
Krupp's 14″ gun and carriage .	Plate XVI.
German naval carriage	Plate XVII.
German turret carriage . . .	Plate XVIII.
Prussian gun-lift	Plates XIX., XX.
Krupp's gun-lift	Plate XXI.
Hydraulic buffer	Plate XXII.
Traversing and running-back gear 11″ gun	Plate XXIII.
English 10″ casemate carriage .	Plate XXIV.
English 10″ casemate carriage (high)	Plate XXV.
English 11″ C. P. carriage . .	Plate XXVI.
English 35-ton carriage . . .	Plates XXVII., XXVIII.
Moncrieff's 7″ depressing car. .	Plate XXIX.
Vavasseur's carriage	Plate XXX.
Hydro-pneumatic ship-carriage .	Plate XXXI.
Swedish 27-cm. gun-carriage .	Plate XXXII.
Austrian siege carriage . . .	Plate XXXIII.
Prussian siege carriage . . .	Plate XXXIV.
Krupp's 21-cm. siege carriage .	Plates XXXV., XXXVI.
Krupp's 15-cm. siege carriage .	Plate XXXVII.
English 40-pdr. siege carriage .	Plates XXXVIII.
Moncrieff's hydro-pneum. siege carriage	Plate XXXIX., XL.
Austrian mortar carriage . . .	Plate XLI.
German mortar carriage . . .	Plate XLII.
Krupp's 28-cm. mortar carriage	Plate XLIII.
Russian mortar carriage . .	Plate XLIV., XLV.
English sling wagon	Plate XLVI.
Lischine's hospital tent . . .	Plate XLVII.

English "*Armstrong*" 10″ on casemate carriage, same report, Fig. 46, Appendix L.

French sea-coast carriage 27 cm. rifled gun, Fig. 67, Appendix L, "*Ordnance Report*," 1877, and p. 544.

American carriage for 8″ rifle. *Ibid.*, Appendix P.

American carriage for 12″ rifle. *Ibid.*, Appendix T.

American carriage for 12″ rifle. *Ibid.*, 1876, p. 96, Pl. III.

American carriage for 9″ converted rifle. *Ibid.*, 1871, Appendix I., p. 134.

Flank-defense carriage for Gatling gun. *Ibid.*, 1879, Appendix I.^{5}, p. 163, and Plates I., II., III.

Moncrieff . . . . . "*Van Nostrand's Mag.*," xv. 375.
Overbank, *Maquay*, Br. * "*Engineer*," xliv. 88.
Gun truck, Penn. Ra'y. * "*Engineering*," xxvi. 492.

Report on depressing gun-carriages, by Board of Ordnance Officers U. S. Army, Washington, 1873. Refers to 58 systems, parts, and accessories, pp. 19, 20. And illustrates —

Service barbette carriage, 15″.
Benton's apparatus for maneuvering guns.
Buffington's counterpoise carriage.
Capt. J. Wall Wilson's device for checking recoil.
Capt. W. R King's counterpoise carriage.
Capt. W. R. King's depressing carriage.

See also HYDRAULIC COMPRESSOR, *infra*.

Gun'-cot'ton. Cotton rendered explosive by treatment with sulphuric and nitric acids. See p. 1036, "*Mech. Dict.*"

Modes of manufacture and considerations of its stability, in "*Report of the Chief of Ordnance, U. S. A.*," 1877, p. 458, *et seq.* See also *Ibid.*, 1879, Appendix I., pp. 130–132.

On cannon, effect of . . * "*Scientific American Sup.*," 2618.

Punchon's improvements in the manufacture of gun cotton are thus described: —

"The cotton is first thoroughly cleansed by boiling it in an alkaline solution and exposing it to a current of air, and then again boiling it in clean water. After the second boiling it must be again thoroughly dried, first by a centrifugal machine, and afterward by being passed over a current of hot air, the wet meeting the cold current, and as it dries rising to a temperature of about 120° F. The cotton, in charges of one pound each, is then steeped for five minutes in a bath containing three parts of sulphuric acid and one part of nitric acid, after which it is taken out and placed in an iron cylinder, and a perforated piston, about 8″ in diameter, is forced down upon it by hydraulic pressure. The excess of acid pressed out of the cotton passes through the perforations in the disk and is pumped off. The cotton is then placed in glazed earthenware jars, which are covered in order to prevent any heating taking place, the jars being placed in a current of cold water, where they are allowed to remain for 24 hours, after which the cotton is taken out and again thoroughly washed, and while yet damp is passed between rollers until it is reduced to a very fine powder; this process being gone through while the compound is damp, prevents any possibility of its explosion. The powder is then mixed with a certain quantity of sugar, nitric acid, and water, into a pulpy mass, which, after being strained through a fine sieve, is carefully dried in a temperature never exceeding 120° F. The manufacturing process is finally completed by passing it through rollers under very high pressure, by which means it is compressed into a hard substance and rendered almost impervious to damp. The gun-cotton intended for blasting purposes is made into thin cakes, broken and irregular in size, but for rifle cartridges it is made in small pellets, similar in form and size to rape seed."—"*Universal Engineer.*"

Gun Hand'-tools.

Ball seater.
Breech wrench.
Burgoyne.
Capper.
Cartridge capper.
Cartridge loader.
Countersink.
Extractor.
Gun brush.
Intrenching spade.
Loading plug.
Primer.
Primer extractor.
Re-capper.
Re-loading tool.
Re-primer.
Uncapping knife.

Gun Har-poon'. A harpoon projected by a gun. Used in whaling. See HARPOON.

Gun Lift. A hoisting arrangement for mounting and dismounting cannon.

Ordnance Report, 1877, Plates XIX., XX., gives views of Prussian gun lift.

Plate XXI., Krupp's gun lift.

Gun Ma-chines'.

Barrel boring machine.
Breaking down machine.
Bullet machine.
Bullet-patching machine.
Butt lathe.
Cartridge heading machine.
Cartridge varnishing machine.
Charcoal grinding machine.
Clamp-milling machine.
Coiling machine.
Cupping machine.
Drawing machine.
Dusting machine
Glazing barrel.
Granulating machine.
Gun stocking machine
Gun stock lathe.
Impression machine.
Incorporating mill.
Lead wire apparatus.
Loading machine.
Mixing machine.
Pebble-powder machine.
Pellet-powder machine.
Pistol rifling machine.
Powder dusting machine.
Powder pressing machine.
Priming machine.
Rifling machine.
Tapering and crimping machine.

Gun'pow-der. See references: —

"Compensators," *Totten* . . * "*Sc. American*," xxxvi. 305.
Incorporating mill, Br. . . * "*Engineering*," xxv. 37.
Manufacture of, *Hay* . . . * "*Engineering*," xxv. 1, 37, 95.
Mixing machine, Br. . . . * "*Engineering*," xxv. 37.
Modern history of, "*Jour. Soc. of Arts.*" "*Van Nostr. Mag.*," xxi. 203.
Pebble-powder machine . . * "*Engineering*," xxv. 236.
Densimeter . . . . . * "*Engineering*," xxv. 236.
Manuf. "*Revue Industrielle*" "*Van Nostr. Mag.*," xvi. 305.
Sifting reel, Br. . . . . * "*Engineering*," xxv. 37.
Breaking-down machine . . * "*Engineering*," xxv. 95.
Charcoal grinding mill, Br. . * "*Engineering*," xxv. 37.
Granulating machine, Br. . * "*Engineering*," xxv. 138.
Dusting reel . . . . . * "*Engineering*," xxv. 138.
Glazing barrel . . . . . "*Engineering*," xxv. 138.
Drying stove . . . . . * "*Engineering*," xxv. 198.
Pellet powder machine . * "*Engineering*," xxv. 198.
Grinding apparatus, Br. . . * "*Engineering*," xxv. 37.
Work: *Dupont* . . . . . "*Amer. Artizan*," xvii. 369.
Hydraulic pressure apparatus * "*Engineering*," xxv. 95.

See also list under "EXPLOSIVES."

Systems and modes of manufacture of gunpowder are detailed in Appendix K, "*Report of Chief of Ordnance U. S. A.*, 1877, p. 437, *et seq.*

British	p. 438.	"Krupp's" . .	p. 454.
Russian	p. 445.	French	p. 455.
"Wicuer" powder	p. 451.	"Wetteren" . .	p. 457.
German	p. 452.	Austrian . . .	p. 457.

Materials, proportions, processes, machinery, tests, packing, storage, etc., *Crispin & Baylor's* report, "*Ordnance Report*," 1879, * pp. 91–134.

See also report on cauuon powders of the following shapes, etc. : —

Hexagonal.	Polyhedral.
Sphero-hexagonal.	English pebble.
Octohedral.	Progressive.

"*Ordnance Report*," 1879, Appendix II., 7, * p. 85, *et seq.*
Ibid., Appendix I., * pp. 122–130.
See also : —
"*Ordnance Manual*," 1861.
"*Handbook on the Manufacture of Powder.*" (British.)
Benton's "*Ordnance and Gunnery.*"
Cooke's "*Naval Ordnance and Gunnery.*"
Marvin's "*Granulation of Powder.*"

Gun'pow-der Pa'per. A substitute for gunpowder. *Powder-paper* consists of paper impregnated with a mixture of potassic chlorate, nitrate, prussiate, and chromate, powdered wood-charcoal, and a little starch. The powder-paper is rolled into the shape of a cartridge of any required length or diameter. It is said that no explosion can take place except by way of contact with fire. Also that the powder paper leaves no greasy residue on the inside of the gun, produces less smoke, gives a less violent recoil, and is less impaired by humidity than gunpowder. With equal charges, by weight, of gunpowder and powder-paper, the penetrating power of the latter is 5-16ths greater than that of the former. — "*Pop. Science Monthly*," x., p. 253.

Gun Stock'ing Ma-chin'e-ry. Includes machines for

Bedding the barrel.	Placing the butt plate.
Bedding the lock.	Turning the stock, etc.
Bedding the guard.	

Gun Stock Lathe. See GUN STOCK, p. 1042, "*Mech. Dict.*," also LATHE, p. 1264, *Ibid.*

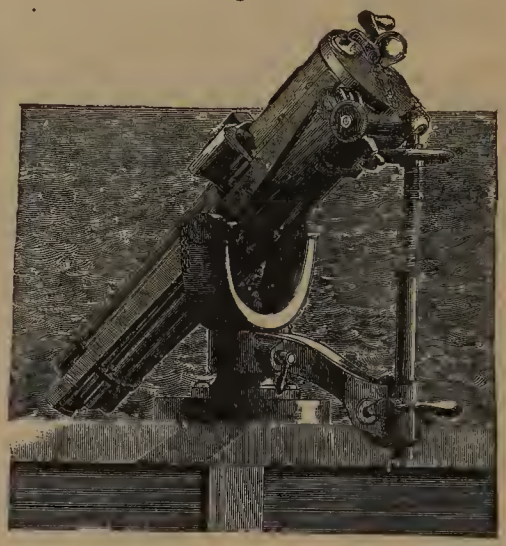
Gun'-tack-le Pur'chase. (*Nautical.*) A form of tackle, also known as a *double purchase*, having two single-sheave blocks. Fig. 6159, "*Mech. Dict.*"

Gun'wale Gun. A light Gatling gun fixed upon the gunwale, and so adjusted that it may be depressed 30°. Fig. 1294. With this power of depression, combined with the swivel-mounting, the weapon may be made to command the whole range of approach of boats for the purpose of boarding.

Gun'wale Winch. (*Fishing.*) A roller with hand crank, mounted on the boat's gunwale, to haul in a fishing line.

Gut Belt'ing. Lathe or machine belting made of cat-gut. Treatise on gut belting, "*Iron Age*," xix., March 15, p. 1.

Fig. 1294.



"*Gatling*" *Gunwale Gun.*

Gut Hook. A coupling hook and eye for round gut belts.

Gut'ta-per'cha Soft'en-er. (*Dentistry.*) A small pan in water-bath over an alcohol lamp; used in bringing gutta-percha to a molding temperature.

Gutta-percha product, E. Indies "*Scientific Am. Sup.*," 2415.
Provision and uses, *Bolas* . . "*Scientific Am. Sup.*," 4009.

Gut'ter Plane. A molding plane with a semi-cylindrical sole, and a bit of corresponding shape. Used in planing out gutters in stuff for eave-troughs.

Gym-nas'tic Ap'pa-ra'tus. See EXERCISING MACHINE; HEALTH LIFT, etc.

Gyn'æ-co-log'i-cal In'stru-ments. (*Surgical.*) Those for operating in cases peculiar to females. See list under SURGICAL INSTRUMENTS.

Gynæcological table, *Foster*,* "*Med. Record*," May 24, 1879.

Gy'ro-pig'eon. A flying object simulating a pigeon in flight. Used as a flying target in shooting matches. Projected by a spring trap. Fig. 3708, p. 1700, "*Mech. Dict.*"

Gy'ro-scope.

Electro-magnetic apparatus to demonstrate the revolution of the earth. *Du Moncel's* "*Exposé des Applications de l'Electricité*," iv. 176.

Gyroscope, *Deane* . . * "*Scientific American*," xxxiv. 244.
Fessel . . . . . * "*Manuf. & Builder*," ix. 133, 157.
Gruey, Fr. . . . * "*Scientific American*," xl. 41.
Electrical, *Hopkins* . * "*Telegraphic Journal*," vi. 276, 331.
* "*Scientific American*," xxxviii. 335.

H.

Hai-tha'o. A species of gelatine used in giving body to tissues and paper.

It resembles Irish moss, and may be derived either from the *Gehelium corneum*, a seaweed of Java, or from the *Phearia lichenoides*, peculiar to Mauritius. It is treated with hot acetic acid, afterwards with water, and finally with ammonia. The residuum dissolved in boiling water furnishes, on cooling, a jelly which is dried, and forms the commercial article. It was first used for alimentary purposes, and is now used as a size, and also as a substitute for gold-beater's skin. When placed in water it takes up about 500 times its own weight of the fluid. It is only soluble in boiling water, and insoluble in weak or diluted acids, alkaline solutions, and ether, but is attacked by sulphuric and other concentrated acids.

Half Back Saw. A hand-saw having a back stiffened to a distance about half the length of the blade from the handle.

Half Clear. (*Glass.*) Said of glass, a portion of the surface of which has been depolished by any means, such as acid, grinding, etc.

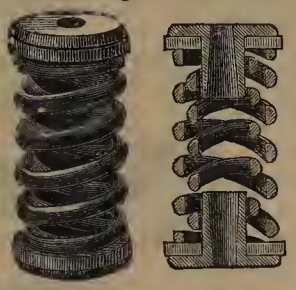
Half-crys'tal Glass. (*Glass.*) A French term for *lime*-glass. *Crystal* answers to the English *flint* glass.

Half-el-lip'tic Spring. A carriage spring composed of one set of plates, like a half ellipse. See Figs. on p. 143, *supra*.

Half Hatch'et. A hatchet with one straight side, all the projection of the bit being on the side toward the hand. A shingling hatchet.

Half Hose Coup'ling. A coupling having at one end a corrugated tubular portion on which the hose is bound, and at the other a sleeve internally threaded to receive an iron pipe.

Fig. 1295.



Half-round-bar Spiral Spring.

Half-round'-bar Spi'ral Spring. (*Railway.*) A coil spring made of half-round steel rod. Fig. 1295 shows it in a double nest form.

Fig. 1296.

Flanged Half-S Hopper Trap.

Half-round' Spade. (*Whaling.*) Used in cutting the blanket-piece free from the carcass as the lifting tackle and blubber hook draw upon the piece in flaying.

Half-S Hop'per Trap. A sewer trap with a single bend; half the letter S in form. Fig. 1296 shows the form, and also a man-hole with cover.

Half-shov'el Plow. (*Agric.*) A plow intended for rooty land. The blade is of steel, and

Fig 1297

Half-shovel Plow.

has one straight side; it is braced by a lay to prevent its being broken or bent. A broad iron plate is attached to the beam, and the colter may be changed from a jumping to a cutting colter.

Half Spring. A spring with but one set of leaves; like a half-elliptic spring, shown at *d*, Fig. 1136, p. 480, "*Mech. Dict.*," and Figs. 450–452, p. 143, *supra*.

Half Trap. A sinking bend in a sewer pipe, like a half-S, not having the rising portion. See Fig. 1296.

Hame. A curved piece of wood or metal, two of which are fitted to the collar; they have draft eyes to which traces and chains are attached.

The attachments are: —

Hame clip; a metallic link by which the tug is attached.

Hame link; at the lower end of each hame, for the hame strap to pass through.

Hame ring; on the hame, for the rein to pass through.

Hame strap; to couple the hames around the collar.

Hame terret; a rein ring in coach harness.

Hame tug; the forward loop on the trace; attached to the clip.

Ham'mer. (*Stone Working.*) Stone hammers are of various kinds, with faces or edges, plain or notched. Sometimes one end has a point (the *peen*) which is practically a pick, and used in *pointing* ashlars. See Stone Dressing.

See Bush hammer.	Mallet.
Cavil.	Patent hammer.
Crandall.	Peen hammer.
Double-face hammer.	Pick.
Face hammer.	Stone hammer.
Hand hammer.	Tooth axe.

(*Surgical.*) Used in osteotomy. The percussor used in auscultation is also a hammer or mallet.

See under the following list, which includes also other striking tools, including sledges, mauls, hatchets, axes, and picks: —

Adze.	Mason's hammer.
Axe.	Mattock.
Ballast hammer.	Mill pick.
Ball-peen hammer	Miner's pick.
Beating hammer.	Nail gun.
Bench hatchet.	Nail hammer.
Blacksmith's sledge.	Napping hammer.
Blocking hammer.	Patent hammer.
Brad driver.	Pavior's hammer.
Brad hammer.	Pavior's rammer.
Bricklayer's hammer.	Peeling axe.
Broad axe.	Peen hammer.
Bull-head axe.	Percussing hammer.
Bung start.	Pick.
Bush hammer.	Pick-axe.
Calking beetle.	Pick hammer.
Calking mallet.	Pick mattock.
Carpet hammer.	Plugging mallet.
Cavil.	Quartering hammer.
Claw hatchet.	Railroad axe.
Coal sledge.	Rammer.
Crandall.	Ring mallet.
Cross peen hammer.	Riveting hammer.
Dental mallet.	Set hammer.
Dog-head.	Sharp-peen hammer.
Double face hammer.	Shingling hatchet.
Drift hammer.	Ship's axe.
Driving hammer.	Sledge.
Electro-magnetic mallet	Spalling hammer.
Engineer's hammer.	Spike maul.
Face hammer.	Steak hammer.
Farrier's hammer.	Stone axe.
Fireman's axe.	Stone-cutter's hammer.
Flaking hammer.	Stone pick.
Flanging hammer.	Straight-peen hammer.
Geological hammer.	Striking sledge.
Half hatchet.	Swaging mallet.
Hammer pick.	Tamping pick.
Hand-drilling hammer.	Tinner's hammer.
Hand hammer.	Tooth axe.
Hatchet.	Top maul.
Hawsing beetle.	Trimming hammer.
Horse-shoe hammer.	Turning hammer.
Knapping hammer.	Turning sledge.
Lathing hatchet.	Welding hammer.
Mallet.	Wood chopper's maul.

Refer to: Cushioned hammer, *Bradley*.
* "*Scientific American Sup.*," 737
* "*Engineer*," xlii. 221.
Helve hammer, Cuyahoga Iron Works.
* "*Amer. Manuf.*," Dec. 12, 1879, p. 7.
Pneumatic hammer, *Sholl*, Br. * "*Engineer*," xliii. 369.
Power hammer, *Hasse-Simon*, * "*Engineer*," xlviii. 412.

Ham'mered Ar'ti-fi'cial Stone. An artificial stone compacted by means of blows.

The ingredients and proportions vary with the facilities of the place of manufacture. *Béton*, as made by M. Coignet, is made of sand 5, lime 1, hydraulic lime 0.25, which are mixed with a shovel, water being sparingly used, and the compounded materials violently ground in a tempering mill and rammed in molds. See p. 278, "*Mech. Dict.*"

The material to which the name of *hammered artificial stone* has been given is made by the application of the stroke of the steam hammer upon properly mixed proportions of hydraulic and common limes, hydraulic cements, pulverized iron slag, sand, broken stone, marble or granite, clays and minerals, inclosed in properly constructed molds and dies. It is made by proper disposition of the ingredients, to imitate marble, and, by carving the interior faces of the molds, to assume any ornamental configuration.

Ham'mer-less Gun. One without exterior hammer; usually fired by concealed spring-pin. The term may include the needle and bolt guns.

That shown in Fig. 1298 is by Greener, of Birmingham, England. It is shown by longitudinal section. The barrels are hinged to the breech-frame in the usual manner, but in-

Fig. 1298.

Hammerless Gun.

stead of the ordinary gun lock with outside hammers, the tumblers *A* are made nearly in the form of an elbow lever. These tumblers have their upper ends curved forward, and are provided with a small rounded point, which is arranged to strike through a small hole at the center of the breech piece instead of the ordinary firing pin. The lower front portions of the tumblers *A* are extended forward in the form of a flat arm, and these arms are curved laterally inward, so that their inner ends nearly meet at the center, each arm terminating with a small rounded projection on its lower side. The tumblers are in a recess which also contains the mainspring. (Referred to in the plural, as the gun is double barreled.)

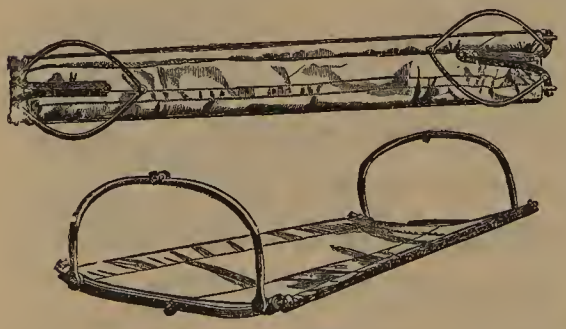
To one of the projections in rear of the joint is pivoted a pendant *C*, which plays loosely in a vertical slot in the center of the front arm of the breech frame, directly in front of the converging arms of the tumblers. This pendant has a hook-shaped projection which engages under the front ends of the arms of the tumblers, so that when the rear ends of the barrels are raised the hook raises the arms of the tumblers far enough to permit the dogs *B* to engage in a notch in the tumblers, thus automatically cocking the arm,

To hold the hook *C* back far enough to engage with the arms of the tumblers, a pin extends through a projection on the under side of the barrels. The triggers operate upon the rear arms of the dogs for firing the arm.

Ham'mer Pick. A stone-mason's tool having a hammer face and pointed peen at the respective ends of the head. A *pick-hammer.*

Ham'mer Strap. An iron strap stapled at its rear end on a wagon tongue, and having an eye at

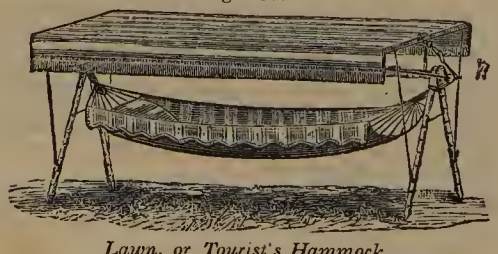
Fig. 1299.



British Navy Hammock.

its forward end which rests on the double tree. The handle of the *hammer*, so called, goes through

Fig 1300.



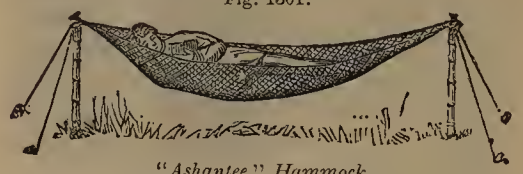
Lawn, or Tourist's Hammock.

the eye, the double-tree, and the tongue, and bears the strain in pulling.

Ham'mock. A suspended netting for reclining or sleeping.

Fig. 1299 is Stone's (Br.) portable swinging bedstead with canvas sacking. It is capable of being folded up and stowed,

Fig. 1301.



"Ashantee" Hammock.

being especially intended for a customary hammock arrangement on board ships of war.

Fig. 1300 is the Gwynfè (*Leycester*, Br.) self supporting hammock tent which stands by itself independently of ropes, trees, or pegs. The awning can be moved to any position.

Elastic suspension, *d'Ancora*, Italy * "*Sc. Amer. Sup.*," 1682.
Mosquito net frame, *Volle* . . . * "*Sc. Amer.*," xxxviii. 339.

Fig. 1301 shows the "Ashantee" hammock on slinging apparatus.

Ham'mock Clews. (*Nautical.*) The gatherings at the ends of a hammock formed by a *grommet* and *knittles* at each end, and by which it is suspended.

Ham'mock Cloth. (*Nautical.*) Canvas to protect the hammock from wet when stowed in the nettings on deck.

Ham'mock Net. Open-work or netted hammock.

Ham Try'er. A long bodkin for probing a ham, to detect by smelling the condition as to soundness around the bone.

Han'cock In'spi-ra'tor. See INSPIRATOR.

Hand. (*Fire-arm.*) The part of the stock gripped by the hand, and which may be either *straight* or *pistol-gripped.*

Hand Blow'er. A blower or bellows worked by hand. See Figs. 347, 348, pp. 111, 112, *supra.* Also Fig. 3891, p. 1768, "*Mech. Dict.*"; also list under BLACKSMITH'S TOOLS, p. 291, *Ibid.*; and list of AIR APPARATUS, pp. 25, 26, *Ibid.*

Hand Bolt'-cut-ter. A bolt-cutting machine, worked by hand-power. See Fig. 367, p. 117, *supra.*

Hand Car. (*Railway.*) A light car, driven by hand-crank and gearing, operated by those riding

Fig. 1302.

Inspection Hand-car.

Fig. 1303.

Three-wheeled Hand-car.

on the car. See various kinds in *Forney's "Car-builders' Dictionary,"* Figs. 43–47. See also INSPECTION CAR.

Penn. Railway . . . . * "*Engineering*," xxv. 44.
Phila. & Reading R. R. . * "*Scientific Amer. Sup.*," 2754.
* "*R. R. Gazette*," xxiii. 107.
Sheffield . . . . . * "*R. R. Gazette*," xxiii. 123.

Hand Clamp. A species of vise for holding parts in apposition while nailing, glueing, or fast-

ening by other means. See Fig. 1310, p. 560, "*Mech. Dict.*" See list of CLAMPS, p. 199, *supra.*

Hand Corn-plant'er. A hand implement forced into the soil and dropping corn into the opening. See Fig. 1470, p. 627, "*Mech. Dict.*," Fig. 2383, p. 1057, *Ibid.*

Hand Cul'ti-va'tor. A garden cultivator, which runs with a wheel in front, and carries a

Fig. 1304.

Hand Cultivator.

hoe, the penetration and direction of which are governed by means of the handles.

Hand Drill. 1. A drilling machine or tool run by hand. See instances, Fig. 2374, p. 1055, "*Mech. Dict.*"

Refer to: —

Quick-speed	* "*Engineer*," xliv., 454.
Bellamy	* "*Scientific Amer*," xxxix. 115
Wiley & Russell . . .	* "*Iron Age*," xxi., April 11, p. 3.

2. A machine for drilling seed in rows. See HAND SEED-DRILL, *infra.*

Hand-dril'ling Ham'mer. (*Stone.*) One used with the chisel in jumping holes in rock for blasting or splitting by plug and feather. The hammer is of steel, and weighs from 3 to 8 pounds.

Hand Hoist. A lifting apparatus worked by hand, as in some species of winch. Specifically, an arrangement of pulley-blocks known as the *differential.* See Fig. 821, p. 257, *supra,* and Fig. 1647, p. 701, "*Mech. Dict.*"

Hand'-hole Trap. A sewer-trap, made with a hand hole, through which may be reached any obstruction which has caught in the bend. See HALF-S HOPPER TRAP, *supra.*

Hand Joint'er. A small machine for trueing the edges of boards or staves. A *buzz-planer.* See HAND MATCHER.

Han'dle Net. (*Fishing.*) A dip-net stretched on a hoop, with a handle.

Han'dlers. (*Leather.*) The vats in which the hides brought from the beam-house are first placed, hanging lengthwise and parallel to each other. The vats have a weak infusion of oak bark. Otherwise known as *stringers.*

Hand Line. (*Fishing.*) A line, hooked and baited, and held in the hand, a *trawl* line, for instance; in contradistinction to a *set* line, or a *fly* line.

The hand-line has one or two hooks baited and sunk near to the bottom, or thrown to any desired distance by means of a weight, and managed from the shore or a boat.

Or, it is drawn rapidly over the surface of the water behind a boat, either with a bait attached or a shining object, such as a spoon.

Han'dling. 1. (*Leather.*) Taking the sides or skins out of the vats into the air, smoothing them out, and piling them on one side to drain, after which they are returned to the *stringers.* Each time they are handled they are returned to a stronger ooze.

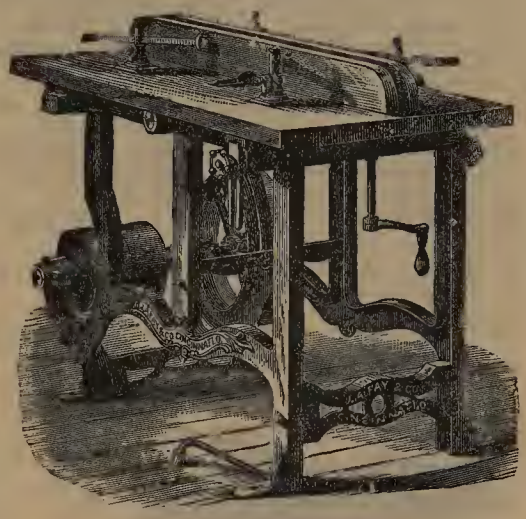
(*Ceramics.*) The operation of putting handles on ware, such as ewers, etc. The handles are molded separately.

Hand Mag'ni-fi'er. (*Optics.*) A series of 3 lenses giving various magnifying powers, whether used separately or in combination, and usually made to carry in the pocket. See LENS HOLDER.

Hand Match'er. A machine for tongueing and grooving short stuff for boxes, furniture, wagon boards, etc.

That shown has two heads, one for tongueing and one for grooving, running on the same arbor below the platen, which is raised or lowered to suit the required depth of work.

Fig. 1305.



Hand Matcher.

The platen is furnished with movable fence and spring rollers, which are adjustable for different thicknesses of stuff which is passed over the heads edgewise, between the rollers and guides, both edges of the stuff being worked without change in the position of the operator.

Hand Mil'ling Ma-chine'. A machine tool, small of its class, the slide adapted to be run by hand.

Fig. 1306 shows a hand machine which is adapted for taking short milling cuts. The adjustment screw for the table passes down through the bed-plate, and is operated from the

Fig. 1306.

Hand Milling Machine.

under side. The cross-slide is adjusted by a screw that projects in front. The sliding table on which the work is placed is operated by a hand lever, and the motion is gaged by an adjustable stop. The spindle is steel, having gun-metal boxes and a taper-hole to receive the shanks of arbors.

The motion of the cutter is by power, that of the work by hand.

In a somewhat larger machine of this class, by *Kelly, Howell, & Ludwig*, and to which power-feed may be applied, the slide has a tool-post attached for the purpose of cutting up stock, facing nuts, or shaping up work from the solid bar or single pieces to be held in the chuck. The tool-post can be removed from the sliding table, and index centers, milling vise, or any milling fixture put on, required for milling, — taps, reamers, nuts, splining shafts, aud any milling suitable to be done on a machine with a screw and level feed. The table has a rack-and-pinion feed, operated by a hand-lever attached to the pinion shaft for a quick motion, and a screw feed so attached that either can be used when required; it also has a cross feed for adjustment or butt milling, drilling, etc. The body of the machine is a large cupboard base with shelves for tools.

Pratt & Whitney . . * "*Thurston's Vienna Rep.*," ii. 225.

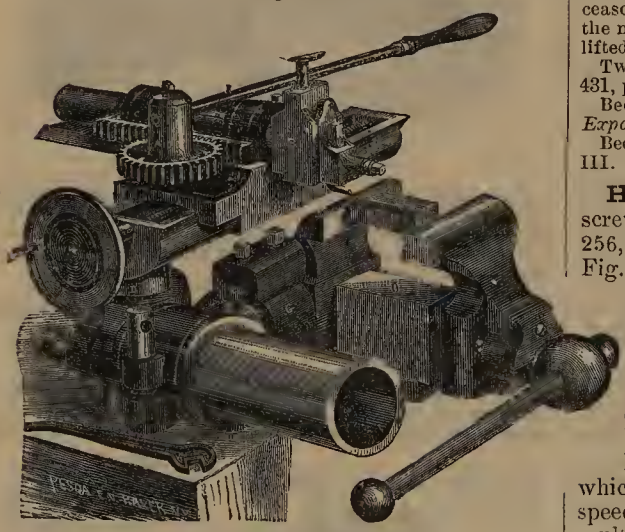
Hand Mor'tis-ing Ma-chine'. A machine in which the force of the blow of the chisel is given by hand. Fig. 3234, p. 1481, "*Mech. Dict.*"

Hand Pla'ner. 1. (*Wood.*) See HAND MATCHER.

2. (*Metal.*) A planing machine, small of its class, and adapted to be worked by hand.

Hall's hand planer is shown in Fig. 1307. The vise is

Fig. 1307.



Hand Planer.

made expressly for the planer, which latter is attached by a socket, and has various adjustments to suit the tool to the piece held in the jaws of the vise. The pinion may be set to suit the length and convenience of the stroke. The tool-head swivels on its center, and may be set forward or back by the adjustable joints. The tool has a perpendicular feed of 2¼". The motion of the lever rotates the pinion, and gives rectilinear motion to the rack which carries the tool-head

Wood-planer, hand-feed, *Richards*, * "*Eng'ing*," xxiii. 274.

Hand Pump. A pump for use in conservatories, washing carriages, etc. Specifically a light implement held in one hand and worked by the other.

See AQUAPULT, Fig. 104, p. 44, *supra*, and HYDRONETTE, *infra*.

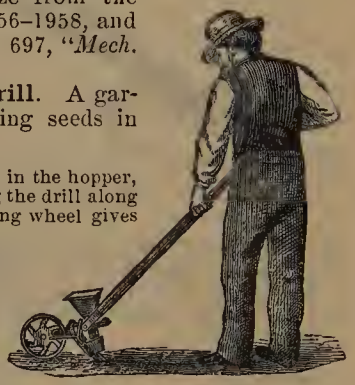
The *proof* pump and *gas-drip* pump of the plumber are other instances.

Carr . . . . . * "*Manuf. & Builder*," ix. 177.
Holland . . . . . * "*Iron Age*," xxiii., June 5, p. 1.
"Reliance," Br. . . . * "*Engineer*," xliii. 170.

Hand Rake. (*Agric.*) A term applied to that class of harvesters in which the gavel is removed from the platform by a rake in the hands of a man who rides on the machine. The automatic or self-rake has superseded the hand rake in this country, but not yet in Europe.

Hand Rock Drill. A smaller form of stone drilling machine, differing but little except in size from the Rock drills, pp. 1956–1958, and Diamond drills, p. 697, "*Mech. Dict.*"

Fig. 1308.



Hand Seed Drill.

Hand Seed Drill. A garden tool, for planting seeds in rows.

The seed is deposited in the hopper, and by simply pushing the drill along the ground, the traveling wheel gives a motion to a slide at the bottom of the hopper, and the seed at once falls through a tube situate behind the colter and drops into the soil. The seed ceases to run through, the moment the drill is lifted off the ground.

Two forms of the broad-cast seeder are shown in Figs. 430, 431, p. 136, *supra*.

Beet-drill, Figs. 132, 133, 135-137, Knight's Report, "*Paris Exposition Reports*," 1878, v., 118 *et seq.*

Beet-drill, Fr., "*Dept. Agric. Sp. Report*," No. 28, Plate III.

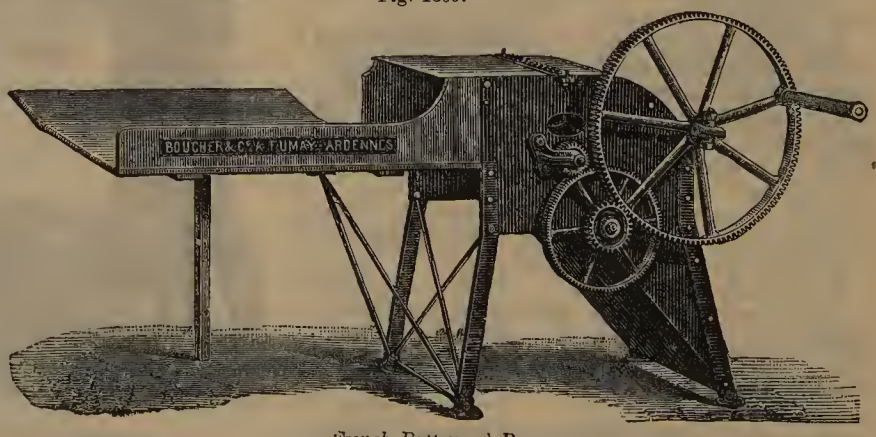
Hand Stock Dies. Cutters for making screws, bolts, and threading pipes. See DIE, p. 256, *supra*; and Fig. 4739, p. 2069, "*Mech. Dict.*;" Fig. 4754, p. 2074, *Ibid.*

Hand'-strap Ap'pa-ra'tus. The dependent lever of the counter-shaft gearing, by which the strap is run from the loose to the tight pulley, or *vice versa*. A *belt-shifter*.

Hand Thresh'er. A threshing machine driven by hand; formerly common in the United States, and yet numerous in Europe. Fig. 1309 shows an excellent French form in which the machine is overshot, and the requisite speed is given to the beating cylinder by the aid of multiplying wheels.

Hand methods of threshing still survive in many countries; the sled shod with flints, the roller sled, and tramping by cattle are shown on p. 2555, "*Mech. Dict.*" The roller is still used in Lombardy; and the *ripple*, in Europe for removing flax seed from the bolls, and in Africa for threshing *dhura*.

Fig. 1309.



French Batteuse à Bras.

Hand Tools. Used in many trades. See under the following heads: —

Adjustable plane.
Adjustable vise.
Adze.
Adze plane.
Angle boring machine.
Angular bench drill.
Angular bit stock.
Anvil vise.
Apple-parer.
Auger.
Auger bit.
Automatic boring tool.
Axe.
Axle setter.
Backing boards.
Back saw.
Bale hook.
Ballast hammer.
Ball-peen hammer.
Ball seater.
Band-saw brazing tool.
Band-saw holder.
Band-saw tongs.
Band setter.
Barley fork.
Barrel busher.
Barrel lifter.
Basin wrench.
Bean slicer.
Beating hammer.
Beef shaver.
Beetle destroyer.
Bench cramp.
Bench drill.
Bench hatchet.
Bench screw.
Bench stop.
Bending tool.
Bent trimmer.
Bevel.
Beveling instrument.
Binder.
Bit.
Bit brace.
Bit-brace die.
Bit-brace tap.
Blacksmith's chisel.
Blacksmith's drill.
Blacksmith's sledge
Blocking hammer.
Block plane.
Boat hook.
Bodkin.
Bolt cutter.
Border knife.
Boring-bar clamp.
Boring-bar wrench.
Boring tool.
Bosom staff.
Bottoming tap.
Bow-back saw.
Bow-drill stock.
Bow saw.
Box hook.
Box scraper.
Brace.
Brad driver.
Brad hammer.
Bramble scythe.
Brazing tongs.
Bread knife.
Bread slicer.
Breast drill.
Breech wrench.
Bricklayer's hammer.
Brick trowel.
Broad axe.
Broadcast seeder.
Brush jack.
Brush-jack needle.
Buck saw.
Buhr dresser.
Buhr rubber.
Bull-head axe.
Bull-nose rabbet plane.
Bung-hole borer.
Bung start.
Burgoyne.
Burner pliers.
Burnisher.
Bush hammer.
Bush hook.
Butter knife.
Button fastener.
Cabinet file.
Cabinet-maker's clamp.
Calking beetle.
Calking chisel.
Calking iron.
Calking mallet.
Calking tools.
Calking vise.
Candy shears.
Cane knife.
Can filler.
Can hook.
Cant hook.
Capper.
Carpenter's clamp.
Carpet hammer.
Carpet stretcher.
Car pusher.
Cartridge capper.
Carver's tools.
Cavil.
Centering tool.
Center mold.
Chain hook.
Chaser.
Cheese knife.
Chemist's tongs.
Cherry.
Cherry stoner.
Chisel.
Churn drill.
Cigar knife.
Circular plane.
Clamp dog.
Clamp screw.
Claw hatchet.
Clevis tongs.
Clipper.
Clip swage.
Clutch drill.
Coal sledge.
Cock wrench.
Cocoa-nut grater.
Cold chisel.
Collar swage.
Combination auger.
Combination plane.
Compass saw.
Concave saw.
Cooper's punch.
Cork arm-board.
Cork presser.
Cork screw.
Corn hook.
Corn knife.
Corundum tool.
Cotton hook.
Countersink.
Crandall.
Crank ratchet-brace.
Cross-file.
Cross-peen hammer.
Crow.
Cupping tool.
Curling stick.
Currier's knife.
Curry-comb.
Curved mattress needle.
Cutting nippers.
Cutting punch.
Dado plane.
Darby.
Dental tools. (See SURGICAL APPARATUS, etc.)
Die.
Die-dog.
Die holder.
Die stock.
Differential ratchet brace.
Ditch cleaner.
Dog head.
Door clamp.
Double clamp.
Double cut saw.
Double ender.
Double-face hammer.
Double-jaw vise.
Double screw vise.
Dowel pointer.
Drain cleaner.
Draining tools.
Drain tile layer.
Draw filing.
Drawing hook.
Drawing knife.
Drift hammer.
Drill.
Drill bench.
Drill holder.
Drilling clip.
Drill press.
Driving hammer.
Duplex punch.
Earth borer.
Egg beater.
Egg whip.
Emery band.
Emery board.
Emery stick.
Emery stone.
Engineer's hammer.
Equilibrium tool.
Expanding drill.
Expanding reamer.
Expansion bit.
Expansive hollow auger.
Extractor.
Face hammer.
Facing tool.
Farrier's hammer
Feather.
Fid.
File.
File card.
File guard.
File holder.
Filings separator.
Finger steel.
Fireman's axe.
Firmer chisel.
Five-cant file.
Flagging iron.
Flaking hammer.
Flanging hammer.
Flat iron.
Flatteuer.
Flatter.
Flesher.
Fleshing-knife.
Flexible sole plane.
Float.
Floor cramp.
Floral tools.
Flower and fruit gatherer.
Fluted tap.
Fluter.
Fluting iron.
Fluting scissors.
Foot vise.
Fork.
Forking spade.
Forming iron.
Foundry ladle.
Fountain pump.
Frame clamp.
Friezing cutter.
Fruit cutter.
Fruit pitter.
Fuller.
Furrow-gage staff.
Furrow rubber.
Furrowing machine.
Gage saw.
Garden fork.
Garden plow.
Garden roller.
Garden tools.
Garden weeder.
Gas-main drill.
Gas tube vise.
Geological hammer
Gimlet.
Gimlet bit.
Glass cutter.
Glossing iron.
Grafter.
Grafting tool.
Grains.
Grater.
Grommet knob.
Grub hoe.
Grub hook.
Gun brush.
Half-back saw.
Half hatchet.
Hammer.
Hammer pick.
Ham tryer.
Hand clamp.
Hand corn planter.
Hand cultivator.
Hand drill.
Hand drilling hammer.
Hand hammer.
Hand jointer.
Hand matching machine
Hand rake.
Hand saw.
Hand seed drill.
Hand seeder.
Hand stock die.
Hand vise.
Hardy.
Harpoon shuttle.
Hatchet.
Hawsing beetle.
Hawsing iron.
Hawk.
Hay band twister.
Hay fork.
Hay knife.
Hazel hoe.
H drill.
Hedge knife.
Hemp knife.
Hoe.
Hollow auger.
Hoof pick.
Hoof punch.
Hook needle.
Horner.
Horse clipper.
Horse-shoe hammer.
Horse-shoer's machine.
Horse-shoer's vise.
Hose wrench
Husking glove.
Ice chisel.
Ice hook.
Ice tools.
Intrenching spade.
Jeweler's rest.
Joiner's clamp.
Jointer plane.
Key-hole saw.
Knapping hammer.
Kneading machine.
Knife.
Knife cleaner.
Knife guard.
Lacing cutter.
Lathing hatchet.
Lily iron.
Lip auger.
Loading plug.
Lock bedder.
Machete.
Machinist's tools.
Mainspring vise.
Mallet.
Mandrel.
Mangle.
Manure drag.
Marking gage.
Marking iron.
Marlinespike.
Mason's hammer.
Mat hook.
Mat pole.
Mattock.
Meat cutter.
Meat rocker.
Meat stuffer.
Microtome.
Mill file.
Mill pick.
Millstone dresser.
Millstone leveler.
Mincing knife.
Mineral dresser.
Miner's bar.
Miner's pick.
Mining wedge.
Miter.
Miter box.
Miter box saw.
Miter jack.
Molder's tools.

Moon knife.
Movable-back saw.
Nail anvil.
Nail gun.
Nail hammer.
Nail puller.
Nail selector.
Napping hammer.
Needle threader.
Nest.
Nicking saw.
Nut wrench.
Pallet knife.
Palm.
Panel saw.
Parallel vise.
Paste jagger.
Patent hammer.
Pavior's hammer.
Pavior's rammer.
Peach Parer.
Peat knife.
Peat spade.
Peeling axe.
Peen hammer.
Perforator.
Pick.
Pick hammer.
Pick mattock.
Pillar file.
Pin bush.
Pinchers.
Pipe cutter.
Pipe die.
Pipe fitter's vise.
Pipe grip.
Pipe-layer's tools.
Pipe threader.
Pipe threading die.
Pipe tongs.
Pipette.
Pipe vise.
Pipe wrench.
Pitching chisel.
Pitter.
Plane.
Plane bit holder.
Plane iron.
Planter.
Plant sprinkler.
Plasterer's brush.
Plasterer's trowel.
Plow.
Plug.
Plug-and-feather.
Plug tap.
Plumb and level.
Plumber's chisel.
Pocket level.
Pod auger.
Point.
Pointer.
Polishing disk.
Polishing iron.
Porte polisher.
Post auger.
Post-hole auger.
Post-hole digger.
Post-hole spoon.
Potato hook.
Pressing irons.
Primer.
Primer extractor.
Pritchell.
Proof staff.
Pruner.
Pruning saw.
Pruning shears.
Pump auger.
Punch.
Putty sieve.
Quartering hammer.
Quick-speed hand drill.
Rabbet plane.
Rag looper.
Railroad axe.
Rammer.
Rasp.
Ratchet brace.
Ratchet drill.
Ratchet wrench.
Razor.
Reamer.
Reaper.
Re-capper.
Red staff.
Reloading tool.
Re-primer.
Reversible saw.
Riffler.
Rigging screw.
Ring cone.
Ring mallet.
Rip saw.
Riveting hammer.
Round iron.
Round moon knife.
Round swage.
Sardine shears.
Sash cramp.
Sash tools.
Sausage chopper.
Sausage stuffer.
Saw.
Saw clamp.
Saw file guide.
Saw filing clamp.
Saw-filing vise.
Saw gummer.
Saw set.
Scissors.
Scoop.
Scraper.
Scraper plane.
Scratch brush.
Scratcher.
Screw clamp.
Screw driver.
Screwing stock.
Screw making tools.
Screw plate.
Screw wrench.
Scuffle hoe.
Seed drill.
Set hammer.
Setting die.
Shackle jack.
Sharp peen hammer.
Shave hook.
Shearer.
Shingling hatchet.
Ship auger.
Ship axe.
Shoe stretcher.
Short-hair knife.
Shovel.
Shunting bar.
Sieve.
Six canted file.
Sledge.
Slot borer.
Sluice fork.
Smoothing iron.
Smooth plane.
Snip.
Soldering iron.
Soldering tool.
Sour kraut cutter.
Spade.
Spanner.
Spawling hammer.
Spice mill.
Spike extractor.
Spike maul.
Spiral auger.
Splitting chisel.
Spoke pointer.
Spoke-shave.
Spoke trimmer.
Sprinkler.
Sprouting hoe.
Square corner swage.
Stamp punch.
Staple fastener.
Steak hammer.
Steel mortar.
Stock and die.
Stone axe.
Stone-cutter's hammer.
Stone pick.
Stone-worker's tools.
Straight peen hammer.
Straw knife.
Striking sledge.
Stuffing brush.
Sudden-grip vise.
Surgical instruments. (See separate list.)
Swage.
Swage block.
Swivel tool.
Swivel vise.
Table brush.
Tack claw.
Tamping pick.
Tap.
Taper tap.
Tap wrench.
Tenon saw.
Tinner's hammer.
Tinner's snips.
Tire bender.
Tire bolt clamp.
Tire setting platform.
Tire shrinker.
Tire upsetter.
Toggle iron.
Tongs.
Tongue and groove plane.
Tool holder.
Tooth axe.
Tooth chisel.
Top maul.
Track chisel.
Track drill.
Tracklayer's tools.
Tram.
Tram staff.
Trenail auger.
Trimmer.
Trimming hammer.
Trowel.
Trust hoop.
Tryer.
Try square.
Tube beader.
Tube brush.
Tube chuck.
Tube cleaner.
Tube cutter.
Tube expander.
Tube fastener.
Tube scraper.
Tube stopper.
Tube tongs.
Turning hammer.
Turning sledge.
Turning steel.
Turn pin.
Turpentine tool.
Twist drill.
Uncapping knife.
Upending tongs.
Upright vise.
Upset.
Vegetable cutter.
Veneer scraper.
Vine shear.
Vise.
Vise clamp.
Wall scraper.
Washer cutter.
Weather-boarding saw.
Weed scythe.
Welding hammer.
Well-hook.
Wire bender.
Wood-chopper's maul.
Woodworker's clamp.
Worker.
Worm auger.
Wrench.
Wrench and pipe cutter.
Wrench handle.
Wringer.
Y.

Hand Wheel. 1. The brake-wheel on a car platform.

2. The throttle-wheel of a large marine or pumping engine.

Hand Winch. A hoisting apparatus worked by hand. See pp. 2776, 2777, "*Mech. Dict.*" A *crab.* Fig. 1499, p. 640, *Ibid.*

Hang'er Bolt. A screw-bolt, coarse-threaded at one end to enter wood, and threaded at the other end for a nut.

Hang'ing Block. (*Nautical.*) A block through which the *top-sail* tye is rove, then through the tye-block on the yard, and the standing part made fast to the mast head.

Hang'ing Cut'ter. A colter depending from the plow-beam. See COLTER, Fig. 662, p. 210, *supra.*

Hang'ing-leg Boil'er. The Galloway boiler, which may be called a form of Cornish in which the large single flue is traversed by vertical water-pipes, which are thus exposed to the horizontal course of the products of combustion.

See Fig. 5626, Plate LXI., opp. p. 2326, "*Mech. Dict.*" Also *p*, Fig. 5621, p. 2327, *Ibid.*

Hang'ing-tube Boil'er. One having water-tubes depending in the flame space; closed at the lower ends and the upper ends secured in the crown-sheet of the fire-box. The flame circulates among these tubes, sometimes directed in its course by a baffle-plate, and passes to the chimney through a straight central flue.

See Figs. 5629, 5633, Plate LXI., opp. p. 2326, "*Mech. Dict.*" Also Figs. 2684, and *B*, Fig. 2685, *Ibid.*

Hang'ing Wall. (*Mining.*) The layer of a rock or wall over a lode.

Hank-dry'ing Ma-chine'. The hanks are placed on perforated rotating rollers or winches, and the lower ends hang in the dye of the beck. The yarn is thus alternately steeped and aired. — "*Textile Manufacturer.*"

See also WINCING MACHINE, "*Mech. Dict.*," and * "*Scientific American Sup.*," 1763.

Han'o-ve'ri-an Bit. (*Manége.*) A straight or curved cheek bit, with two or more loops for reins upon the lower or long arm; also a loop at the end

of the short cheek, for receiving the leather cheek, and a rein-ring at the cheek-piece.

Han'o-ve'ri-an Chif'ney. (*Manége.*) This differs from the regular Hanoverian by having a short movable arm attached, in the same manner as the Chifney; the curb-chain is attached to the stationary cheek.

Har'bor Gas'ket. (*Nautical.*) A broad gasket, one on every other seam of the sail, to show a well-furled sail when in port.

Har'dened Glass. Glass treated by the process of M. Siemens, at Dresden.

It is formed under hydraulic or other pressure which gives the desired hardness independent of any tempering. By means of this process larger glass panes can be formed than was possible before. The glass is stronger than the tempered glass of De Bastie in the proportion of 5 to 3. The fracture is fibrous, not crystalline like the ordinary glass. At an examination instituted by the "Gewerbeverein," a leaden bullet, weighing 120 grains, was dropped upon plates of ordinary and pressed glass, supported at the four corners. The ordinary glass was fractured by a fall of the bullet from a height of 300 millimeters, while the pressed pane fractured at a height of 2,000 millimeters. A second specimen of the latter was subjected to a fall of 3,000 millimeters without breaking.

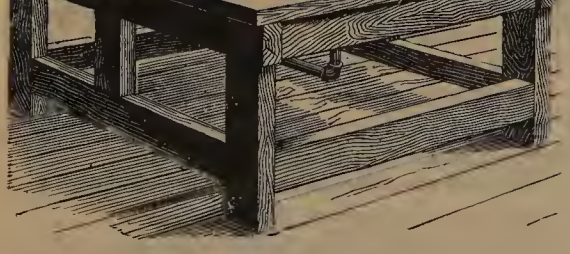
See GLASS, TEMPERED, *supra*, for references.

Hard'en-ing Ma-chine'. A machine for rubbing and pressing hat bodies in order to felt the materials, increasing the density, diminishing the size, and making the material hard and compact.

The machine for hardening wool hat bodies operates by means of a reciprocating rubbing board. It is placed upon a strong wooden frame which serves as a table on which the hat-body rests. Into this table is fitted a steam box which is perforated on top to allow the steam, which is admitted by a pipe, to penetrate the hat bodies to be hardened.

Fig. 1308 shows a machine with two rubbing boards which receive a rapid reciprocating motion from two adjustable wrist-pins fitted to the fly-wheel disks on each end of the driving shaft. One of these rubbing boards, the nearer one, is shown thrown back and out of work. The other one is in operation.

Fig. 1310.



Hat-body Hardening Machine.

The hat bodies are built into a pile and laid upon the steam-box, coarse hardening cloths being sandwiched between each and pieces of cloth of suitable size and shape being laid inside each hat body. The object of these interposed cloths is to prevent the adherence of the hats, one to another. Two of them laid in immediate contact and rubbed while hot and wet would soon coalesce and be impossible to divide. The rubbing board, which is also covered with coarse cloth and is somewhat smaller than the hat-body, is then lowered upon the hat bodies and held down by a post which is hinged to a spring on the ceiling of the room and has a yielding pressure upon the rubbing board.

Three to five hat bodies are thus partially hardened at one operation; the projecting portions, however, not having been acted upon, the hat bodies are removed and so disposed as to bring under the rubbing board at the next operation the portions which were formerly the edges.

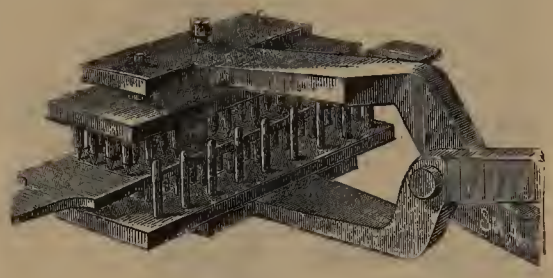
This operation completed, the hat bodies are ready for the *sizing kettle*, or battery, when to be made by hand, or to be fulled in a fulling mill if they are to be farther treated by machinery.

In some factories a separate machine is used to harden the tips of hat bodies. It consists simply of a rubbing board which acts upon a round steam chest of suitable size, upon which the hat body is placed after the sides have been hardened in the ordinary hardening machine.

Hard'en-ing Tongs. A tool to hold steel articles during the process of tempering.

A pair of tongs having T-shaped jaws is provided with pointed pins which bear upon opposite sides of the article, and prevent it from twisting out of shape when it is plunged into the water to cool, while it allows the water to com-

Fig. 1311.



Hardening Tongs.

pletely surround the article. One of the jaws is movable and is capable of adapting itself to tapering surfaces.

Hard Paste. (*Ceramics.*) A name applied to the material of real porcelain, which abounds in silex, and is so vitreous as to break with a fracture like glass. See PORCELAIN.

Hard'ware, House, Car'riage, Wag'on, etc. See under the following heads: —

Acorn-headed bolt.
Anchor shackle.
Ankle shackle.
Anti-rattler.
Anti-rattler fifth wheel.
Apron fastener.
Awning cleat.
Awning foot.
Awning hinge.
Awning slide.
Awning slide-rod.
Axle block.
Axle clip.
Axle lubricator.
Axle saddle.
Axle yoke.
Back spring.
Back stay end.
Ball-joint hinge.
Band.
Barn-door hanger.
Barn-door rail.
Barrel hook.
Bench sail-hook.
Beveled washer.
Bevel-head bolt.
Billet.
Bit.
Blind-fast.
Body loop.
Boiler-patch bolt.
Bolster plate.
Bolster spring.
Bolt (varieties, see list).
Bow iron.
Bow joint.
Bow spring.
Bracket.
Bridge bolt.
Bridle bit.
Buggy spring.
Bull's eye.
Butt.
Butt-hinge.
Button-head bolt.
Can hook.
Cap screw.
Car-door hanger.
Carriage bolt.
Carriage spring.
Carriage spring-lock.
Car seat spring.
Caster.
Cattle tie.
Chain stay.
Chain swivel.
Clip king-bolt.
Clip plate.
Clip yoke.
Coach clip.
Coach-door handle.
Coach hinge.
Coach lock.
Coach screw.
Collar holder.
Collar nail.
Combination lock.
Cone head bolt.
Corner iron.
Countersunk head screw.
Countersunk head square shank bolt.
Crate hinge and hasp.
C-spring.
Cultivator point bolt.
Dash.
Dash foot.
Dash frame.
Dash lamp.
Dead lock.
Deck hook.
Door handle.
Door hanger.
Door spring.
Door stop.
Double washer.
Draft tug.
Drawer lock.
Drive knob.
Elevator bolt.
Elliptic-head bolt.
Elliptic spring.
Escutcheon.
Eye.
Eye bolt.
Eye ferrule.
Feed-box hasp.
Felloe holder.
Felloe joint bolt.
Felloe plate.

Fifth wheel.
Fifth wheel trueing-plate.
Flange bushing.
Flush bolt.
Foot rail.
Front stay end.
Full circle.
Gaff-topsail hook.
Gate latch.
Gridiron step.
Grommet.
Guard bolt.
Gut hook.
Half elliptic spring.
Half spring.
Hame stud.
Hammer strap.
Hand-rail bracket.
Hanger bolt.
Hanger screw.
Harness bracket.
Harness snap.
Hasp.
Head-block plate.
Hexagon head cap screw.
Hinge.
Hinge nail.
Hod.
Hook.
Hook and eye screw bolt.
Hook and eye turnbuckle.
Hound plate.
Hungarian nail.
India-rubber spring.
Jail lock.
Janus-faced lock.
Joint end.
Joint eye.
Joint holder.
Joint washer
Key.
Key bolt.
Key fastener.
Key-head bolt.
Keyless lock.
Key ring.
King bolt.
King-bolt tie.
King-bolt yoke
Knob screw.
Lacing hook.
Lag bolt.
Lag screw.
Lap ring.
Lariat swivel.
Letter lock.
Lining nail.
Lock (varieties, see list).
Locking baggage check.
Locking plate.
Lock nut.
Loop bolt.
Loop head.
Loop yoke.
Loose pin hinge.
Machine bolt.
Machine screw.
Maiden nut.
Match hook.
Metallic chain.
Mousing hook.
Nail.
Neck-yoke socket.
Needle.
Night latch.
Nut.
Nut lock.
Offset.
Oval point set screw.
Pad bracket.
Pad lock.
Perch loop.
Perch iron.
Perch plate.
Perch stay.
Picket pin.
Pin.
Pipe hook.
Plate hinge.
Plate washer.
Platform spring.
Platform spring shackle.
Plow bolt.
Pole coupling.
Pole crab.
Pole eye.
Pole socket.
Pole tip.
Pole yoke.
Port hinge.
Prop block.
Prop block washer.
Prop nut.
Railway track bolt.
Reach.
Reach plate.
Reach socket.
Ring.
Ring bolt.
Ring boot.
Ring handle.
Rivet.
Riveting burr.
Riveting knob.
Rockaway band.
Rope clamp.
Round countersunk bolt.
Round countersunk square head bolt.
Round-head cap screw
Rub iron.
Rudder brace.
Rudder gudgeon.
Saddle bracket.
Saddle clip.
Safety bolt.
Safety hook.
Safety loop.
Sash lock.
Sash spring-catch.
Scandinavian lock.
Screw eye.
Screw-head key.
Screw hook and eye hinge.
Screw hook and strap hinge.
Screw knob.
Scuttle.
Seat fastener.
Seat lock.
Seat spring.
Self-locking hook.
Self-mousing hook.
Set screw.
Sewer entrance.
Sewer trap.
Shackle.
Shackle bolt.
Shackle flap.
Shaft bolt.
Shaft coupling.
Shaft eye.
Shaft loop.
Shaft rubbers.
Shaft tip.
Shank spring.
Sheet slip.
Shifting carriage rail.
Shifting rail.
Ship ring bolt.
Ship spike.
Shoe bolt.
Side-bar.
Side-bar-spring shackle.
Side scuttle.
Single screw turnbuckle.
Sinking bolt.
Skein screw.
Sky-light guard.
Sky-light lift.
Slat iron.
Sleeve nut.
Sleigh-shaft coupling.
Sleigh-shoe bolt.
Snap.
Socket washer.
Spider hoop.
Spike.
Spiral spring.
Sponge basket.
Spring band.
Spring-bar clip.
Spring block.
Spring buffer.
Spring cap.
Spring clip.
Spring coupling.
Spring hanger.
Spring hinge.
Spring seat.
Spring shackle.
Spring shelf.
Spring stud.
Spring washer.
Square countersunk bolt.
Square head bolt.
Square shank bolt.
Stall rug.
Stanchion.
Standard brace.
Stay chain hook.
Stay eud.
Stay-end clip.
Stay-end tie.
Steeple-head bolt.
Step.
Step bolt.
Step pad.
Step shank.
Stool swivel.
Stove bolt.
Strap hinge.
Strike.
Stump joint.
Surface box.
Swivel.
Swivel hook.
Tap.
Tap bolt.
T-brace.
Thimble skein.
T-hinge.
Thorough-brace brace.
Threshing machine tooth.
Tile.
Time lock.
Tire bolt.
Top brace.
Top joint.
Top prop.
Top prop nut.
Track bolt.
Triangular washer.
Trip hook.
Triplet spring.
Tufting button.
Turnbuckle.
Vault light.
Vault ring.
V-bolt.
Vehicle spring.
Ventilating grate.
Wagon box.
Wagon-box-rod plate.
Wagon coupling.
Wagon lock.
Washer.
Wear iron.
Whiffletree bolt.
Whiffletree brace.
Whiffletree circle.
Whiffletree coupling.
Whiffletree hook
Whiffletree plate.
Whiffletree tip.
Whiffletree tongue.
Whip-socket.
Window button.
Window latch.
Window quadrant.
Window sector
Wire nail.
Wood screw.
Yale lock.
Yoke.

Hare'lip In'stru-ments. (*Surgical.*) For trimming the edges, approaching the lips of the suture, securing the parts in position.

They consist of —

Scalpel.
Scissors.
Clamp.
Ligature instrument.
Plastic pin.
Pin conductor.

See pp. 59, 60, Part II., *Tiemann's* "*Armamentarium Chirurgicum.*"

Har-mon'ic An'a-ly'zer. An integrating machine, invented by Sir William Thomson, for producing mechanically the harmonic constituents of meteorological, tidal, and other curves, in order to obviate the large amount of work involved in their calculation by the ordinary methods.

"*Engineering*" . . . . . * xxx. 561.

Har-mon'ic En'gine. A small electro-magnetic engine, by Edison. A diapason with weighted arms vibrates between electro-magnets, and works a small water or air-pump.

* "*Scientific American*" . . . . . xxxix. 17.

Har-mon'i-con. A musical instrument with bars which are beaten with mallets.

The bars are made of wood, metal, stone, glass.

For *stone*, see LAPIDEON, p. 1253, "*Mech. Dict.*"
For *glass*, see HARMONICA, p. 1061, *Ibid.*
For *wood*, see WOOD HARMONICON, p. 2809, *Ibid.*, and references *passim.*

Also "*Atlantic Monthly*," vol. xxxix., pp. 523-525, where, in an article by the author on the "*Crude and Curious Inventions at the Centennial*," 1876, are described and represented the

Marimba of Angola . . . . . p. 523.
Marimba of Central Africa . . . . pp. 524, 525.
Gambangs of Siam and Malaysia . . pp. 526, 527.

See also references *passim.*

Har-mon'ic Tel'e-graph. A telephone which sends messages by audible musical tones. — *Gray.*

See Figs. 6266-6269, pp. 2516-2518, "*Mech. Dict.*"

Papers by *Pope* . . "*Jour. Am. Electrical Society*," i. 1.
"*Scientific American*," lxiii. 368.
* "*Scientific Amer. Sup.*," 2088, 2097.
* "*Jour. Soc. Teleg. Eng.*," vii. 356.
"*Iron Age*," xvii., April 13, p. 3.

Har-mo'ni-um. An English name for the parlor reed-organ. Distinguished from the *harmonicon*, which has bars.

Har-mon'o-graph. An instrument invented by Mr. Tisley, by which Lissajou's and Melde's figures may be drawn upon paper by a capillary glass pen containing a colored ink.

The ingenious instrument, which was originally employed merely to make curious curves, far exceeding in variety and eccentricity those of the rose-engine lathe, has now attained great use and interest in producing graphic representations of sound vibrations from tuning forks or the voice. According to the circumstances, the curves are traced on a paper, smoked glass, or traveling ribbon, or are merely projected by mirrors upon a screen.

In a simple form the harmonograph consists of two pendulums vibrating in planes at right angles to one another, and having their rods continued above their centers of oscillation. One of these rods carries a small flat table upon which is fastened the paper upon which the figure is drawn, and the other actuates a rod which carries the pen. The center of gravity, and therefore the time of oscillation of the latter pendulums, can be altered to any required amount, so that the proportions between the periods of vibration of the two pendulums can be brought to any desired ratio to represent harmony, unison, discord, or indeed to illustrate all the harmonic combinations of waves of sound and music. The curves and figures traced out by this instrument are of great beauty, and by a recent addition to it, whereby the paper may be slowly rotated by a clock-work movement, while the vibrations are going on, very extraordinary figures are produced, some of which illustrate in a remarkable degree the laws of interference and of the polarization of light.

"*Scientific American Supplement* . . . . . 1188.

See also references under CURVE INSTRUMENT, p. 236; and ELECTRICAL DIAPASON, p. 293, *supra;* and LISSAJOU'S CURVES, PENDULUM INSTRUMENT, *infra*.

Har'ness. Diagrams, showing the principles of the disposition of heddles and harness for various kinds of weaving, may be found in *Laboulaye's* "*Dictionnaire des Arts et Manufactures,*" article "*Tissage,*" vol. iii., edition 1877.

Har'ness Grease.

Whale or neat's-foot oil	3 quarts.
Castor oil	1 pint
Ivory black	½ pound
Rosin	½ pound.
Beeswax	½ pound.
Burgundy pitch	½ oz.
Prussian blue	½ oz.

Mix. Boil for half an hour.

Harness blacking . . "*Scientific American,*" xxxvi. 81.

Har'ness Hitch. (*Nautical.*) A kind of hitch for securing harness casks. See *h*, Fig. 2513, p. 1105, "*Mech. Dict.*" See also LIFTING TACKLE, *infra*.

Har'ness Snap. See SNAP HOOK, 23 illustrations, Fig. 5246, p. 2229, "*Mech. Dict.*"

Harp. (*Music.*) A stringed instrument played by the hand and having a compass, formerly, of 5½ octaves, but increased by Erard to 6¼. It is written on two lines for the two hands. The lower line usually has the F clef, the upper the G. Erard's *double-action harp* is tuned in C♭; it has 7 pedals by which the strings may be raised a semi-tone or a whole tone. See Berlioz's "*Treatise on Modern Instrumentation and Orchestration,*" p. 62, *et seq.*

Har-poon'. A barbed javelin.

The harpoon employed in the capture of the sword-fish off the New England coast consists of a barb with jointed ears, and fastened to one end of a rope of several hundred feet in length, to the other end of which is attached an empty, well-bunged barrel, to serve as a buoy. The end of a long handle carries a pointed iron stem, over which the socket of the harpoon head referred to, usually called the *lily-iron*, is slipped. The fisherman stationed at the end of the bowsprit of a sloop drives the harpoon into the back of the neck of the fish; and if the lily-iron is fastened in the flesh, it slips off from the stem of the handle, which is pulled out as the fish darts away, and the rope and buoy are thrown overboard. The fish swims off, but becoming fatigued by the drag of the buoy, comes again to the surface, when it is drawn up by the rope and killed by a lance.

List of patents on harpoons, projectiles, rockets, bomb lances, etc., used in fishing and whaling: —

2,195	*Carsley*, Twisted flukes.
3,490	*Moore*, Vial of explosive mixture in the harpoon.
4,764	*Allen*, Bomb lance.
4,865	*Holmes et al.*, Harpoon with movable flukes.
4,872	*Randall*, Pivoted expanding flukes.
5,949	*Allen*, Gun harpoon.
7,410	*Brown*, Gun harpoon; mode of attaching line.
7,572	*Brown*, Gun lance; mode of attaching line.
7,610	*Brown*, Harpoon; mode of attaching line.
7,777	*Albertson*, Harpoon with hinged shank.
8,703	*Burt*, Explodiug harpoon.
8,843	*Sonnenberg et al.*, Electric whaling apparatus.
8,862	*Stillman*. A lance in a harpoon. Movable flukes.
9,047	*Brand*, Gun harpoon or bomb lance. Wings on shank.
15,577	*Scholfield*, Gun lance, spiral wings.
16,819	*Scholfield et al.*, Bomb lance, spiral wings.
17,173	*Sibley*, Gun lance with wings taken from the gun.
17,312	*Brand*, Bomb lance with folding spiral wings.
17,370	*Grudchor et al.*, Bomb lance with percussion arrangement.
17,407	*Sibley*, Gun lance with wings.
18,848	*Kelly*, Harpoon with movable flukes.
18,568	*Bates*, Bomb lance with spiral tail.
18,824	*Scholfield*, Gun lance with wings.
19,363	*Harkness*, Harpoon with lance.
21,219	*Sibley*, Bomb lance with wings.
21,278	*Scholfield*, Gun lance with barbs.
21,949	*Doyle*, Harpoon with pivoted head.
22,054	*Andrews*, Bomb lance with interior fuse tube.
23,827	*Comins*, Bomb lance with folded wings.
24,371	*Brown*, Bomb harpoon, expanding flukes.
25,020	*Goodspeed*, Bomb lance with wings.
30,869	*Briggs*, Bomb harpoon with expanding flukes.
31,190	*Roys*, Shoulder gun for harpoons and lances.
32,830	*Goodspeed et al.*, Guide for bomb lance.
35,474	*Roys*, Rocket harpoon and bomb.
35,476	*Roys*, A whale raiser. A barbed instrument led down the harpoon line to a sunken whale.
38,207	*Adams*, Harpoon, with semi-revolving head.
40,387	*Allen*, Bomb-lance, with perforated fire-proof diaphragm.
46,437	*Barker*, Exploding harpoon.
49,548	*Pierce*, Harpoon and bomb lance.
54,211	*Roys et al.*, Rocket harpoon.
64,045	*Smith*, Gun harpoon, grooved head, to receive the pivoted barb.
71,763	*Kelley*, Gun harpoon with pivoted head.
78,675	*Kelley*, Bomb harpoon, pivoted flukes.
90,868	*Pierce*, Bomb lance.
97,693	*Rechtens*, Harpoon with bombs.
126,388	*Freeman*, Bomb harpoon.
171,553	*Cunningham*, Bomb lance.
201,793	*Kelleher*, Gun and bomb lance.
201,794	*Kelleher*, Bomb lance.
206,694	*Taylor*, Harpoon with expanding flukes.
211,777	*Pierce*, Harpoon gun.
211,778	*Pierce*, Bomb lance.
214,707	*Roys*, Bomb lance.
222,003	*Brand*, Bomb lance.

Har-poon' Gun. A small cannon, or a shoulder gun, for hurling harpoons or lances. See list, *supra*.

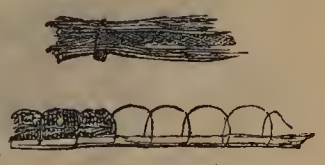
Har-poon' Shut'tle. (*Hydraulic Engineering.*) The standard tool for sewing mats for hydraulic dikes and jetties.

Fig. 1312.

Harpoon Shuttle.

Its weight is about 10 pounds. It is wound with 200 feet of No. 14 wire, and in operation is used by three men, two above and one below the mat. Two men pass the shuttle back and forth and around the pole in stitches 12″ to 18″ long, while a third tramps down the brush and holds the wire while the next stitch is being made. The shuttle may also be used in making an overhand or back stitch, the pole being omitted.

Fig. 1313.



Shuttle Fastening.

It was also the method employed in sewing to a wire; 2 shuttles were used in the harness-stitch, and a short shuttle in the chain stitch, and in combination with a hook needle it is used as a bobbin in making the lock-stitch. Of these methods the sewing to a wire and the lock-stitch turn the wire too short; the chain-stitch is of difficult manipulation, and the harness-stitch is expensive to make, and has great backslip when broken.

Har'ris-Cor'liss Engine. A form of Corliss engine. See Fig. 5666, p. 2341, *"Mech. Dict."*

Engine works . . . . . * *"Sc. American,"* xli. 175.

Har'row. (*Agric.*) An implement with teeth, lying flatly upon the ground, over which it is drawn to level the soil or cover seed.

The following are shown on pp. 1067, 1068, *"Mech. Dict."*:

Brush harrow.	V-harrow.
Jointed harrow.	Double harrow.
Folding harrow.	Share harrow.
Rotary harrow.	Spiked-cylinder harrow.

See also *Chain* harrow, Fig. 589, p. 188, *supra.*
Disk harrow, Fig. 831, p. 261, *supra.*
Disking machine, Fig. 832, p. 261, *supra.*
Geddes harrow, Fig. 1194, p. 396, *supra.*

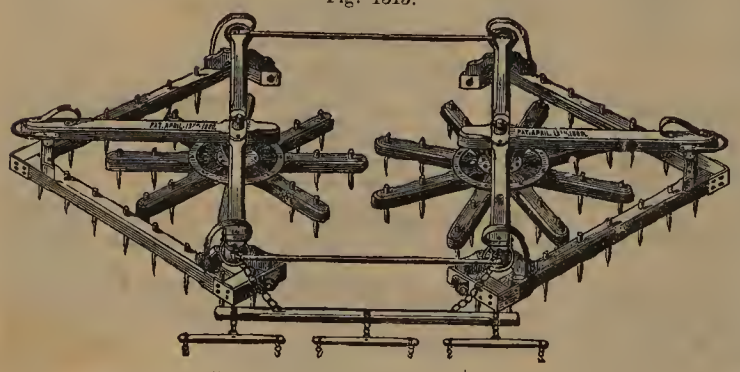
The "Penn" harrow is a Protean instrument consisting of a rotary portion revolving in a V-shaped section, and adapted to be used either single or double, and in various forms: (*a*) the rotary portion with one V, or (*b*) with two V's, forming a square; (*c*) upset and resting on its sled during removal from place to place (Fig. 1314); (*d*) the single V, or (*e*) the

Fig. 1314.

"Penn" Harrow. (*In position to move on its sled.*)

double V, without the rotary; (*f*) the single V upset, the

Fig. 1315.

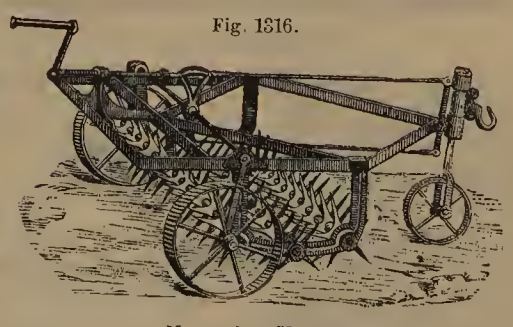


"Penn" Harrow. (*As a Gang.*)

three sled-bows acting as a corn-marker; (*g*) the complete tool (Fig. 1315) with the two V's and two rotary portions.

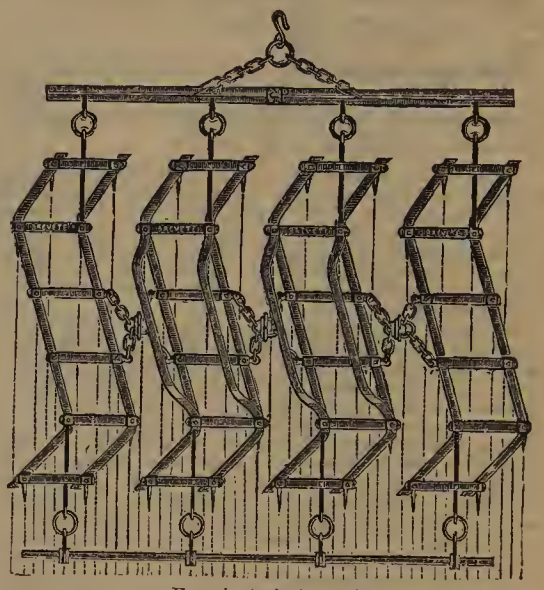
Fig. 1316 shows the Norwegian harrow. It is carried on

Fig. 1316.



Norwegian Harrow.

Fig. 1317.



French Articulated Harrow.

three wheels, by the forward one of which it is guided. It carries two spiked rollers, the depth of penetration of which is adjusted by means of a screw, operated by a crank from

Fig. 1318.

French Ridge Harrow.

the rear, the effect being to raise or lower the sleeve at the apex of the frame upon the pillar of the caster-wheel. The spikes are in fact star-disks, slipped upon an axial rod, and free to move thereon independently.

The French articulated harrow (Puzenat, Bourhon-Lancy) has an equilibrium bar, and is made in jointed sections, from 3 to 6 in number, according to the breadth required. The arrangement of the teeth is such that with a given line of draft the surface of the ground is marked by equidistant lines. Fig. 1317.

Fig. 1318 is the French *herse à billons* (*Souchou-Pinet à Langeais*), or ridge harrow; so called from its flexibility enabling it to lap over a ridge or upon the sides of a cleaning-out furrow; serving to break clods and level minor inequalities upon undulating ground. The *chain harrow*, Fig. 589, p. 188, *supra*, has the same adaptation.

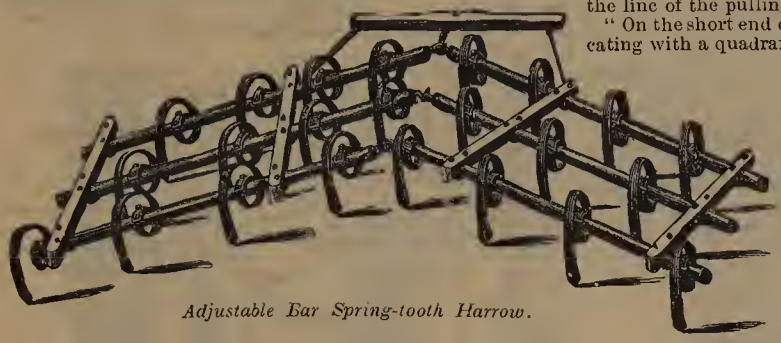
Fig. 1319 shows the adjustable bar spring-tooth harrow, in which the teeth are permanently seated upon and coiled around the round bars of the frame; the bars being held in position by friction clamps, but adjustable therein so as to give the required presentation of the tooth to the soil, to regulate the depth of tilth. This without changing the position of the tooth on the bar. By rolling the bars to which the teeth are attached, forward or backward, the faces of the teeth are placed on an angle with the line of draft, by which they more readily scour, and also produce when at work a vibratory motion in addition to the coil motion, by which they more perfectly pulverize the soil, and free themselves from rubbish.

The two frames of the harrow are connected by a swivel coupling, so that the bars can be changed in either direction without affecting the working of the coupling.

Nishwitz, "Acme" pulverizing harrow is intended to combine the action of a clod-crusher, leveler, and harrow in one implement. A diagonal leveling bar runs upon the ground and carries at its rear edge a series of sword-shaped projecting colters. To the rear of the leveling bar is hinged another bar, from the rear of which projects another row of spring-steel colters, curved in form, beveled to an edge, and set at an angle with the line of draft and also at an angle with the horizon. A lever within reach of the driver (who rides)

is held in position by a ratchet, and enables the operator to control the angular position of the crusher and at the same time raise or depress the colters on the hinged bar at the rear.

Fig. 1319.

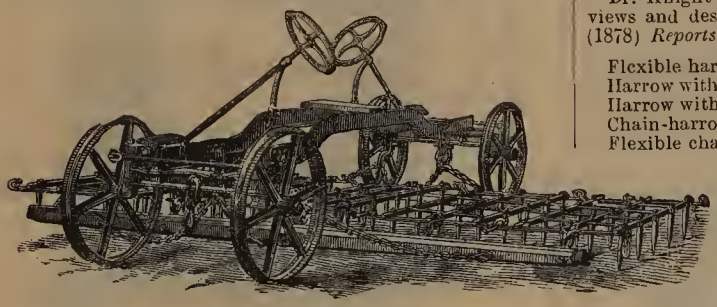


Adjustable Bar Spring-tooth Harrow.

The "Albion" harrow is also a riding implement, but has wheels and shafts. It has spring teeth depending from a bar jointed to the axle. These are curved like those of a horse-rake, but are flat, and their angle of presentation is adjustable to regulate the depth of penetration. This comes very closely to the class of cultivators.

In Europe, Britain and France especially, there is quite a variety of implements embraced in the general class of harrows, and used for cultivating or renewing the surface of ground. They may fairly be called harrows with handles, and are especially used for dragging out the twitch-grass which is such a nuisance in wheat-fields. See Fig. 1322

Fig. 1320.



Steam Harrow.

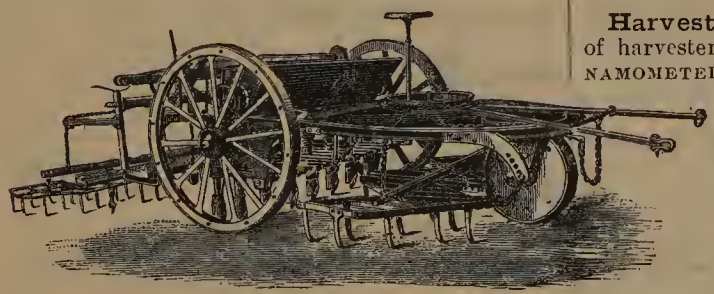
Figs. 1320 and 1321 show the adaptations of the harrow to steam cultivation.

The ordinary steam-harrow (Fig. 1320) covers a breadth of from 12′ to 18′, so that from 40 to 60 acres may be gone over in a day.

The harrow moves in either direction, and can be driven at high speed. The under frames can be removed and rollers or clod-crushers substituted for them.

The machine, Fig. 1321, has a light cultivator or heavy harrow in front of the seeding-colters and a light covering harrow following the same. The seed-drill itself, even of the largest width, requires but so small a fraction of the power of the engines, that it has been combined with the harrows. The drill has a width of 9′. In turning around, the heavy harrows are lifted by the power of the engine, and the whole implement moves at once on to new ground. The lifting and turning action is automatic.

Fig. 1321.



Steam Grain Drill and Harrow.

"The long end of a draft-bar or turning-lever is provided with two arms to which the two ends of the rope are attached. The arms are set at an angle for keeping the tail-rope clear of the implement. The lever itself is held by a vertical stud fixed to the frame considerably behind the steering-wheel. This position of the draft-stud gives the necessary liberty and power to the steering-wheel and enables it to lead the implement at almost any angle out of the line of the pulling-rope.

"On the short end of the turning-lever is a chain communicating with a quadrant on the crank-axle, and as the lever is pulled round, the chain, acting on the quadrant, turns the axle, lifts the frame, and raises the tines out of the ground.

"The plan of operation is as follows: As soon as the cultivator is brought up to the headland, the reverse pull brings the lever around, turns the quadrant, rotates the bent axle, and lifts the tines out of the ground, in which position the implement is held up by a catch; when lifted the required height, the lever strikes against a stop, and the implement turns into new ground. The man, who never leaves his seat, releases the catch, the tines drop into the ground, and the implement is re-drawn across the field." —*Knight's "Paris Exposition* (1878) *Reports,"* * v., 85, 87.

Old English harrow . .	* "*Engineering*," xxvii. 533.
Norwegian, spiked . .	* "*Engineering*," xxvii. 533.
Combined with roller.	
Campbell	* "*Min. & Sc. Press*," xxxviii. 169.
Dobbin	* "*Sc. American*," xxxviii. 199.
Green	* "*Min. & Sc. Press*," xxxv. 249.
Flexible, *Howard*, Eng.	* "*Scientific American Sup.*," 939.
Nicholson, Br.	* "*Engineering*," xxviii. 36.
Duplex, *Rogers* . . .	* "*Iron Age*," xxv., April 8, p. 11.

Dr. Knight's report on Class 76, at Paris, 1878, contains views and descriptions of the following, "*Paris Exposition* (1878) *Reports*," vol. v., pp. 95-98: —

Flexible harrow . . .	*Puzenat.* France.
Harrow with handles . .	*Picksley, Sims, & Co.* England.
Harrow with handles, tine, and frame.	England.
Chain-harrow . . .	England.
Flexible chain-harrow .	*Howard.* England.

Har'row Cul'ti-va'tor. An implement like a harrow, but supported on wheels which limit the penetration of the tines. The distance apart of the tines suits the width of rows of the drilled crop. It is used in Europe in cultivating the intervals of drilled wheat, and in killing the weeds in summer fallows. The frame is vertically adjustable by means of the lever at the rear. (Fig. 1322.)

Fig. 1322.

French Harrow Cultivator.

Harvester. For results of dynamometric trials of harvesters at Paris Exposition, 1878, see DYNAMOMETER, p. 288, *supra.* Also "*Paris Exposition Reports,*" 1878, v., pp. 134, 135.

The table on p. 442 gives a functional classification of harvesters.

Har'vest-er Cut'ter. The sickle of a grain or grass cutting machine. See digest of principles, Plate XXX., p. 1489, "*Mech. Dict.*"

Hat Block'ing Ma-chine. See BLOCKING MACHINE, * p. 109, *supra.*

Hat Brim Stretch'ing Ma-chine. See BRIM STRETCHER, p. 135, *supra.*

Hatch'ing Box. For hatching fish ova. See FISH CULTURE, p. 339, *supra.*

CLASSIFICATION OF HARVESTERS: BY STRUCTURE.

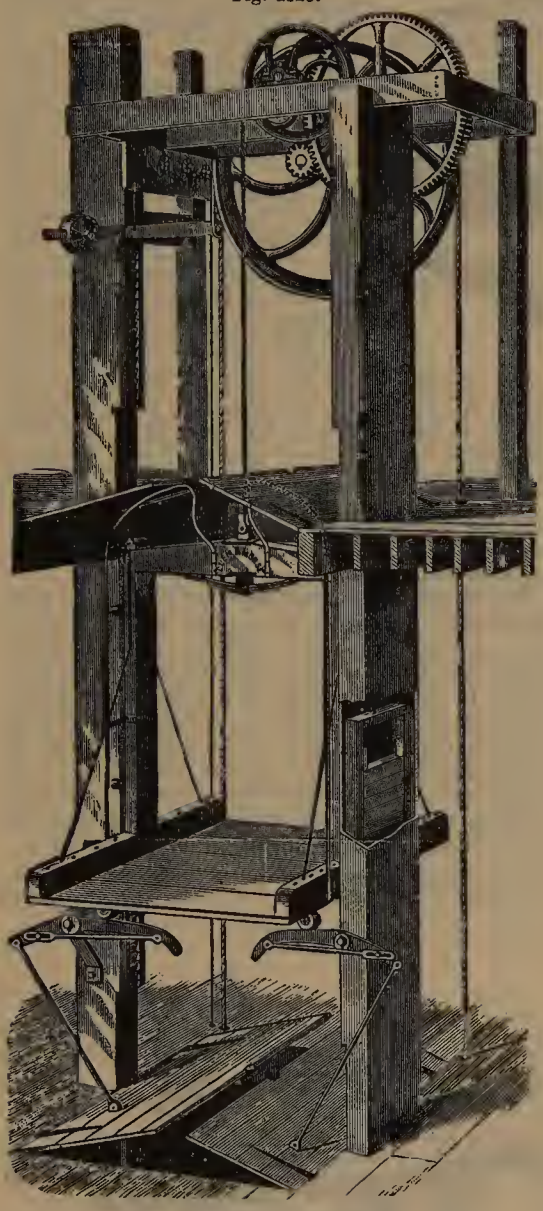
- **Connection of Cutting Apparatus with Frame.**
  - Finger-bar rigidly connected.
    - 1 To main frame.
    - 2 To hinged coupling frame.
    - 3 To vertically sliding frame.
    - 4 To flexible coupling arms.
  - Finger bar hinged.
    - 5 To arms rigid with main frame.
    - 6 To two arms; one rigid, the other jointed.
    - 7 To two arms, both jointed.
    - 8 To a single swiveled bar.
    - 9 To coupling frame jointed to main frame.
    - 10 To coupling frame jointed to secondary hinged frame.
    - 11 To coupling frame vibrating on main axle.
    - 12 To sliding arms.
    - 13 To pinioned shaft moving in vertical rack-ways.
  - F.-bar reversible.
    - 14 Endwise.
    - 15 Axially.
- **Model of Driving Cutter.**
  - 16 By simple gearing.
  - 17 By friction gearing.
  - 18 By planetary gearing.
  - 19 By gyrating gearing.
  - 20 By screw gearing.
  - 21 By changeable-speed gearing.
  - 22 By cams.
  - 23 By belts.
  - 24 By piston moved by compressed air.
- **Style of Cutters**
  - Reciprocating.
    - Rectilinear.
      - Longitudinal.
        - 25 Single blade.
        - 26 Transversely divided blade.
        - 27 Double blades.
      - 28 Inclined.
      - 29 Transverse.
    - Curvilinear.
      - Longitudinal.
        - 30 Curved blade.
        - 31 Blade hung upon hinged arms.
        - 32 Series of pivoted knives.
      - 33 Inclined.
      - 34 Transverse.
  - Rotary.
    - 35 Cutters upon single vertical shaft.
    - 36 Cutters upon single horizontal shaft.
    - 37 Cutters upon series of vertical shafts.
    - 38 Cutters upon endless chain or belt.
    - 39 Cutters upon horizontal worm.
- **Style of finger-bar.**
  - 40 Stiff.
  - 41 Flexible.
- **Track Clearers.**
  - 42 Rigid.
  - Adjustable.
    - 43 Vertically.
    - 44 Horizontally.
  - 45 Vibrating.
  - Yielding.
    - 46 Vertically.
    - 47 Horizontally.
    - 48 Axially.
- **Dividers.**
  - 49 Rigid.
  - Yielding.
    - 50 Front to rear.
    - 51 Side to side.
    - 52 Up and down.
  - Adjustable.
    - 53 Vertically.
    - 54 Horizontally.
  - 55 Vibrating.
- **Draft.**
  - 56 Rigid with cutter frame.
  - Jointed.
    - 57 Upon main axle.
    - Upon cutter frame in rear of axle.
      - 58 Above.
      - 59 Below.
    - 60 Upon cutter frame in front of axle.
  - 61 Independent of tongue.
- **Endless Apron.**
  - 62 Rear delivery.
  - Side delivery.
    - 63 On a level.
    - 64 Elevated.
- **Discharge of grain.**
  - Surface movement of platform.
    - 65 Rollers.
    - 66 Screw conveyors.
  - **Droppers.**
    - Positive movement of platform.
      - Tilting.
        - 67 To one side.
        - 68 To the rear.
      - 69 Swinging and tilting.
      - 70 Swinging.
      - 71 Revolving.
    - Receivers.
      - 72 Vibrating.
      - 73 Rotating.
      - 74 Dumping.
- **Automatic Rakers. — Stationary platform.**
  - Operated from below platform.
    - 75 Teeth upon endless belts or aprons.
    - 76 Teeth upon heads hung on belts.
    - Teeth upon reciprocating heads.
      - 77 Straight path.
      - 78 Curved path.
    - 79 Superposed heads on endless belt.
  - Operated from above platform
    - Reciprocating.
      - Rectilinear.
        - 80 Front to rear
        - 81 Side to side.
      - Curvilinear.
        - 82 Horizontal path.
        - 83 Vertical.
        - 84 Irregular.
    - Rotary.
      - Endless belt.
        - 85 Upon horizontal pulleys.
        - 86 Upon vertical pulleys.
      - About an axis.
        - 87 Horizontal.
        - 88 Vertical.
        - 89 Inclined.
    - 90 Reciprocating and rotary combined.
    - 91 Hand rakers.
- **Reels.**
  - 92 Revolving beaters on horizontal axis.
  - 93 Revolving beaters on vertical or inclined axis.
  - 94 Revolving beaters carried on endless belts.
  - 95 Reciprocating rising and falling beaters.
- **Automatic Binders.**
  - By Fastenings.
    - Material.
      - 96 Cord.
      - 97 Wire.
      - 98 Wooden withes.
      - 99 Paper band.
      - 100 Straw rope.
      - 101 Gavel.
    - Derivation.
      - From the fields.
        - 102 Twisted band.
        - 103 Simple wisp.
        - 104 Loop stitch.
      - From prepared material (cord, wire, etc.)
        - 105 Ends twisted.
        - 106 Ends tied.
        - 107 Ends tucked.
        - 108 Ends twisted and tucked.
        - 109 Ends clasped.
  - By manner.
    - 110 In sheaves.
    - 111 In connected bundles.
    - 112 In perpetual twist.
  - By reception of gavel.
    - Endwise.
      - 113 Through a funnel.
      - 114 Between jaws.
    - Transversely.
      - 115 On endless compressor belt.
      - 116 On jaws.
  - By relation of gavel and tying mechanism.
    - Gavel revolved beneath tying mechanism.
      - 117 Endwise.
      - 118 Axially.
    - 119 Tying mechanism rotated around gavel.
    - 120 Both stationary.
    - 121 Both moving.
    - 122 Gavel swung in semicircle.
- **Hand.**
  - 123 Tables rigid.
  - 124 Tables hinged.
  - 125 Tables swinging.
  - 126 Tables revolving.

Reapers and Threshers. 127.

- **Tedders.**
  - 128 Reels.
  - 129 Kickers.
  - 130 Endless belts.
- **Rakes.**
  - Horse Rakes.
    - Wheeled.
      - 131 Revolving.
      - Lifting.
        - 132 By rider.
        - 133 By draft.
    - Drag.
      - 134 Revolving.
      - 135 Lifting.
  - 136 Hay Cockers.
- **Loaders.**
  - Horse Hay Forks.
    - 137 Harpoon.
    - 138 Grapple.
    - 139 Corkscrew.
    - 140 Tilting.
  - 141 Hay loading rakes.

Hatch'way. The opening in a floor through which goods are lifted or lowered. Fig. 1323 shows automatic hatch doors in connection with a hand-

Fig. 1323.



Automatic Hatchway.

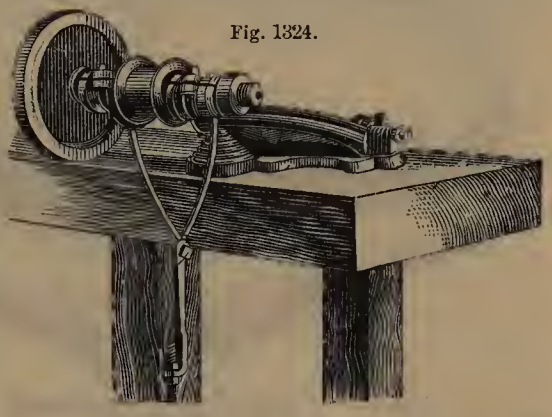
power elevator. The doors are always closed except while the platform is passing through, the platform in its ascent or descent opening the doors which close of themselves when the platform has passed. This is a guard against accidental falling down the hatchway, and also against the spread of fire by the elevator shaft. The rising rods lift the doors in ascending, and the platform actuates levers to lift the doors in descending.

Automatic cone . . . . * "*Manufacturer & Builder*," viii. 53.
* "*Scientific American*," xlii. 358.

Hat-fin'ish-ing Lathe. A machine introduced by John T. Waring. It has a chuck fitted to a lathe spindle and carrying the hat, which, while rapidly revolving, is rubbed with sand or emery paper held against it. This is regarded as a very great advance in the art of hat-making machinery. Previous to this time the wool hat-body, after being sized, was rubbed with pumice-stone and then put on a block to be ironed off and touched up with sand-paper.

The finishing-lathe illustrated in Fig. 1324 is one of the forms yet in use, although in its first purpose, that of sand-papering hats, it has been superseded by later inventions. It

Fig. 1324.



Hat-finishing Lathe.

is now used to retouch the hat after it has been put on the finishing-block, and also to lay the nap with a piece of felt pressed by hand upon the surface while the hat upon the chucked block is revolving.

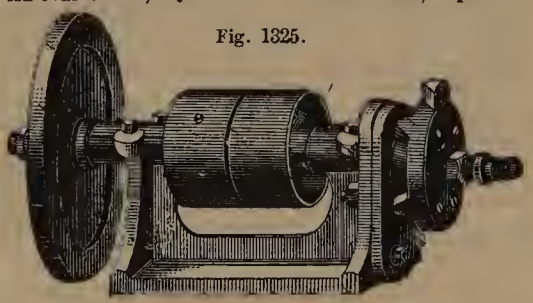
The spindle has its bearings in an adjustable frame which is held up by a helical spring. The lathe spindle is driven by a belt from a pulley above, and when the spindle is elevated by the spring, the loose belt slips on the spindle pulley. When the spindle is depressed by the foot of the operator on the treadle, the pulley is tightened against the belt, and the spindle receives rotation.

When wool hats came into more general use, oval blocks conforming more closely to the shape of the head took the place of the round blocks before in use, and this change made it necessary to use a lathe which turned in an oval path, to be able to finish the oval part of the side crown.

Fig. 1325 shows the Eickemeyer oval hat lathe, the machine in most general use.

An oval chuck, adjustable for various ovals, is placed in

Fig. 1325.



Eickemeyer's Oval Hat Lathe.

front of a lathe spindle, and is provided with a screw to receive the chuck in the hat-block, while an adjustable nut on the chucking screw is used to bring the hat-block into proper position to the oval.

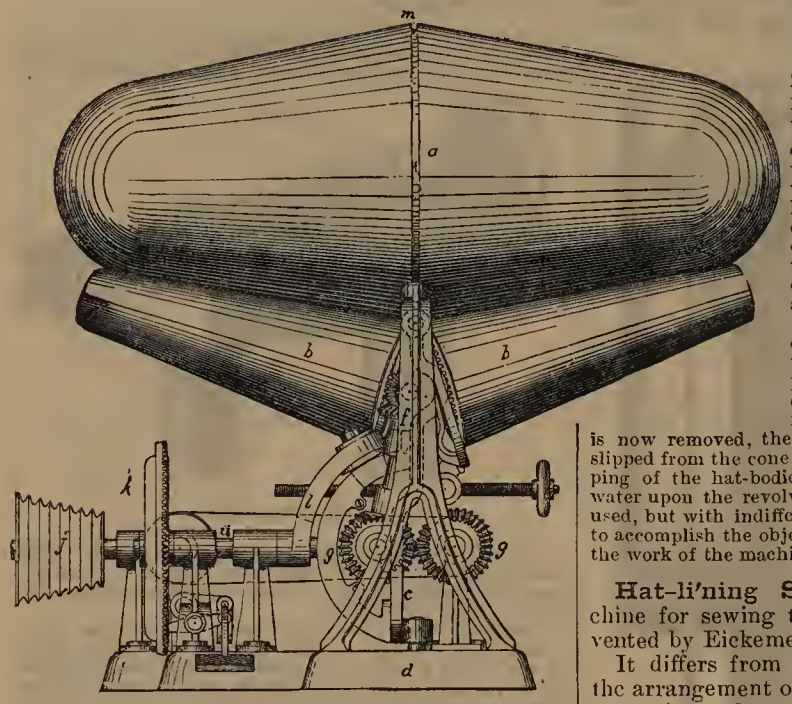
This lathe is used to finish the side crown and brim while the tip is still finished on a round lathe.

Hat-form'ing Ma-chine'. A machine for setting up hat-bodies. The wool and fur body machines are essentially different.

The first improvement in hat-making over the ancient hand processes was the hat-forming machine of Mason, followed by the patents of Grant. These machines consisted of a conical block upon which a web of wool was wound as fast as it was delivered from the carding machine.

Fig. 1326 is a front view of a wool hat former with a double cone upon which the web is wound. This double cone *a* is supported upon four conical rollers, *b*, two of which only are seen in the view. The rollers are pivoted upon a frame *c*, which is supported on a step in the bed-plate *d*, and is also pivoted on the upper end of the standard *f*. The pivot line of the frame *c* is coincident with the pitch line of the two bevel wheels *g g'*; it is at right angles with the crank-shaft *i*, and in a position close to the front of the double cone *a*.

Fig. 1326.



Wool Hat Forming Machine.

The cone pulley *j* is driven from the carding machine, and gives rotation through the gears *g g'* to the rollers *b b*, and thus to the double cone *a*. By means of a cone and pinion on a suitable countershaft, motion is given to the bevel-wheel *k*, shaft *i*, and crank *l*, which give to the supporting frame and forming cone a vibratory motion in a horizontal plane while the cone is revolving slowly on the rollers, the web from the carding machine winding on to the cone.

When a sufficient quantity of wool has been wound upon the double cone to make two hats, the *bat* is cut in two by the operator, who sets one blade of his shears into the equatorial groove which serves as a guide, and separates the two bodies while the cone is revolving.

It is of the utmost importance to lay the woolen web evenly upon the cone, and also to cross the wool fibers so as to make the hat body of equal strength in every direction; and it is also necessary to be able to adjust the supporting rollers to form cones of various shapes, and to adjust the speed to the different sizes of hats to be formed. All the woolen hat formers are therefore made adjustable in these various ways, and answer the requirements in greater or less degree, as the mechanism is more or less perfect.

The hat-forming machine for fur bodies is very different from that used for woolen bodies. Instead of a fine fleece from the carding machine wrapped upon a revolving former, the fur body former is a perforated cone with an interior exhaust blast and a fur picker which sends a fine cloud of hairs toward the cone on which they collect in a bat.

The machine is the invention of Henry A. Wells, who accomplished for the fur hat-body trade what Grant had previously done for the woolen hat-body. Wells's machine, improved by Taylor, Burr, St. John, and others, has disposed of the hatter's bow for ever. With an improved Wells machine 400 hat-bodies of superior quality can be made per day, and these, by dipping in a suitable bath, are made sufficiently firm to be sized into proper shape.

The machine is shown at Fig. 2431, p. 1075, "*Mech. Dict.*" As now used it consists of a feeding apron and a suitable picker which throws the fur upon a perforated cone.

The feeding apron and feeding rollers are upon a frame which furnishes also support for the bearings of the picker cylinder and the main driving shaft. A trunk or covered way is closely fitted to the frame and the cover which encloses the upper part of the picker cylinder. The trunk or conductor has a sectional shape corresponding somewhat with the shape of the former cone, and is adjustable in height by a supporting screw. The former cone is placed centrally upon a revolving table which has an opening in its center communicating with the inlet of the suction blower. The operator who weighs out the quantity of fur required for each hat-body places it evenly upon the feed apron, which is then started; the fur is delivered to the picker and guided by the conductor to the cone, where the fur is held by the pressure of air created by the fan which exhausts the air from the inside of the perforated cone.

When the fur for a hat has all been deposited upon the cone, a wet cloth is thrown over the tip, another cloth wrapped around the sides, and a hollow cap corresponding with the former cone is placed over the whole. The cone, with the hat-body thus held between it and the cap, is removed, another cone placed on the turning-table, and another hat-body formed as before.

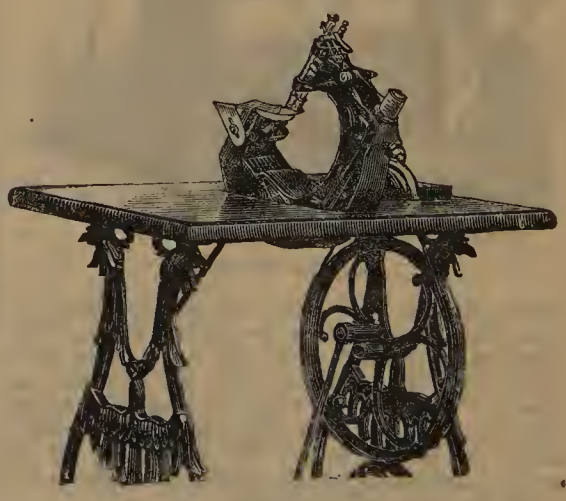
To make the fibers adhere to each other the cone with its cover is then put upon a platform which is suspended by balancing weights over the dipping-tub, and is gradually submerged in hot water. The outer cone is now removed, the cloths taken off, and the hat-body slipped from the cone ready to be sized. To avoid the dipping of the hat-bodies, a sprinkling-pipe which blows hot water upon the revolving hat-body has been to some extent used, but with indifferent success, as more time is required to accomplish the object by the last-mentioned method, and the work of the machine is to this extent diminished.

Hat-li'ning Sew'ing-ma-chine'. A machine for sewing the sweat-leathers into hats; invented by Eickemeyer.

It differs from the ordinary sewing-machine in the arrangement of the work-plate, which is curved to receive and support the side crown on one of its faces while the brim is supported upon a narrow strip. In the presser-foot is a gage which guides the edge of the sweat-leather to the needle. The machine itself is pivoted to the table and can be turned around its driving shaft to enable it to be adjusted at the will of the operator in such a manner that the hat is held up without any further assistance after it has been put under the presser-foot.

The feed is an ordinary four motion which acts in the corner formed by the junction of the brim and side crown,

Fig. 1327.



Hat-sweat Sewing-machine.

while the presser-foot is of a right angular shape and presses upon the exterior of this angle. The hat is thus carried around, guided by the angle, which insures a perfectly even stitching of the sweat near the edge. In most cases the leather is stitched fast to the hat, leaving the stitches visible, while in other cases the edge is stitched fast and the sweat turned over to hide the stitches. By a change of the presser-foot either style can be sewed on the machine.

To make a perfectly smooth edge on the sweat-leather where it touches the forehead, it is desirable to turn the edge of the sweat in a sweat-rolling machine, which is composed of two rollers geared together and supported in a

frame, the upper one held down by a rubber spring to allow it to yield to the varying thicknesses of the leather. After the introduction of the hat-sweat sewing-machine, another improvement in the same direction, namely, a machine to make the hat linings, was invented by Eickemeyer, and improved by Judson. It consists of a table having a round or oval motion, upon which a piece of silk or other material to make the tip is secured, while another piece is put in a folding gage in such a way that the stitching will fasten the edge of the piece that forms the side crown in a circular or oval line to the flat tip.

Judson added to this attachment a pair of rotary shears, and arranged the turn table upon a swinging lever, which enabled him to trim the tips before the side crown was sewed fast.

The use of the pouncing machine has, however, done away with the necessity of lining the hat crown inside, both the outside and the inside being now pounced and presenting a smooth, finished surface.

Hat Ma'king. The manufacture of felt hats in the United States has, by the introduction of improved machinery and methods, reached a high degree of perfection and importance.

Fifty years ago the business was carried on in small establishments in towns and cities and in very small shops, even in villages. In the latter case the implements were almost as simple as those of the shoemaker, and a boss hatter, with one or two apprentices, made the hats for the surrounding district.

Wool and fur, with other hatters' supplies, were furnished by city merchants. The wool was simply carded, and the hatter, with his bow, shaped it into a hat body and then finished it.

The best machinery for making felt hats is of American origin and much of it has found its way into Europe, superintendents and workmen having come to this country to study the American method and become acquainted with the uses of the machines which have been exported to Europe.

This invasion of American machines reminds one of the complaints of the hatters of London, nearly 150 years since, in a memorial to the British Board of Trade, at the extent to which the manufacture of hats was carried on in New England and New York.

Beaver fur hats were formerly considered the best, but as that animal became scarce other furs were substituted for the body, which was covered with beaver fur on the outside. This mode of manufacture has now disappeared, and both soft and stiff felt hats are made of wool or of fur as two distinct branches of manufacture, which are carried on in different establishments and use almost entirely different machinery.

In the wool-hat factories are used all those machines which are ordinarily employed in cloth manufactories to prepare the wool for spinning; while the fur-hat factories have a set of special machines.

The hatter of 50 years ago laid the fur or wool, which had been previously prepared, on a hurdle made of wood or wire, with openings to let the dirt fall through. He then, by means of his bow, scattered the fur in all directions. The bow was usually made of ash, 6′ or 7′ long, with a catgut string stretched between the two ends. With a stick this string was caused to vibrate, and the fur driven from one end of the hurdle to the other. The layer of fur was called a *bat*, was made in a triangular shape, and formed one half of a hat body. It had to be carefully joined to another piece of the same shape, the edges overlapping each other, and the two portions, so united, with a cloth of the right shape between them, were pitted on a hot-plate, while water was sprinkled upon them until the fur became partially felted and the cone-shaped hat-body had become tolerably firm.

The hat-body was now taken to the *battery* to be felted. This process consisted of rolling the body between cloths, continually changing its position in the cloth, while it was kept as hot as possible by dipping it into acidulated water kept boiling in the *sizing-kettle* by a small fire underneath. Special care was taken to shrink the hat body alike all over, and to reduce it from the size of a conical bag almost three times the dimensions of the finished hat-body. When the body was made of wool, and was to be *napped*, a cone of fur, bowed as described, was laid over it and wetted down with a brush until the fur adhered to the body firmly enough to continue the rolling between the sizing cloths, the body being kept hot by dipping it into the sizing liquor, as before, and this was continued until the loose fur had penetrated and formed a part of the body.

To give the hat-body its shape was the next operation, and this was also done on the battery. Having been thoroughly soaked in hot water, the operator laid the hat body on the plank which forms the margin of the battery, with that part of the body which was to form the brim turned up, and while turning it around on the plank pulled out the tip to form the flat portion of the hat crown. The body was now pulled on to a block of the size and shape of the finished hat crown, a cord slipped over the crown, and drawn tight at the junction of the side crown and the brim. In this condition the brim was pulled out flat and smoothed with a piece of metal called the *trencher*. While firmly secured on the block the hat was put in the coloring liquid, and after washing, trying, and stiffening, it was finished by carding the outside when a long, flowing nap was wanted, or it was rubbed over with pumice-stone, when a smooth finish was desired. After the trimming had been put on, the hat was ready for use. All the various manipulations were done by one man who had learned the hatters' trade; and the separation of these, and the division of the hat-makers into *makers*, *blockers*, and *finishers*, did not become general until the *forming* machines had come into general use.

The first improvement in hat making was made by Mason, whose wool hat-body former consisted of a conical block upon which the web of wool was wound as fast as it was delivered from the carding machine. This machine was improved by Grant. See HAT-FORMING MACHINE.

At about the period of the introduction of the wool-hat forming machine, the hat-body *hardening* machine, with reciprocating rubbing board, came into use in hat factories. See HARDENING MACHINE. It consists of a cloth-faced rubbing board, which is rapidly reciprocated upon a pile of hat-bodies lying flatly beneath it, each hat-body having within it a hard cloth, and a cloth also interposed between each body. The pile lies upon the perforated top of a steam box, so that the whole of them are kept saturated with hot steam.

Sometimes a special machine is used to harden the tips of hat-bodies. It consists of a rubbing board acting upon the top of a steam chamber of such shape that the hat-body can be slipped upon it after the sides of the body have been hardened in the ordinary machine.

Wells' machine, improved by *Taylor & Burr*, is described under HAT-FORMING MACHINE. It may be simply stated here in a general way that it consists of an apron to feed the fur, a picker cylinder to loosen and scatter it, and a perforated revolving former or cone, beneath which is an exhaust fan. The fur fed in regulated quantities is finely divided by the picker and sent whirling in the direction of the cone, upon which it collects as the air passes through the interstices and the hairs collect on the outside.

With the more extended use of the machine for forming fur hat-bodies, it became necessary to have better appliances to separate the fur from the hair and to prepare it for the former. This was accomplished in *Rotch's* fur-blowing machine, in which the fur and hair are separated and other impurities removed. This consists of a feeding apron, pickers, and a screen. The fur is presented by feed-rollers to the picker, which combs it out and scatters it, the lighter part into an upper chamber, and the heavier into a lower one, where a screen separates the tussocks of imperfectly treated matter from the hairs and dirt. The latter are removed while the former are passed back to be re-treated. See FUR-BLOWING MACHINE. Fig. 1112, p. 332, *supra*.

After the forming of hat-bodies, both fur and wool, had been successfully accomplished, the sizing or fulling of hats received the attention of inventors, and numerous attempts were made to full hats, but only a few machines proved of any value. James S. Gaylor, of Danbury, Conn., however, invented and patented a four-roller sizing machine which came into general use in wool-hat shops. The hat-bodies were rolled up in a piece of cloth and put between four rollers, which were placed in a hollow casing with their axes at an angle with each other. This position of the rollers caused the roll of hats, which was introduced into the machine at one end, to travel slowly along while turning between the rollers, two of which have, in addition to their rotary motion, a slight vibratory motion sideways, and thus the hats were slowly felted. As stated above, this machine was extensively used in wool-hat factories, but it was superseded finally by the fuller mill, which is now universally used.

The first successful attempt at fulling hat-bodies was in the factory of the Seamless Clothing Manufacturing Co., Matteawan, N. Y., where the manufacture of wool hats was commenced about 1860.

Various styles of mills are now in use. One will be found under FULLING MILL.

The batches of hats are placed in the bed of the machine, and are subjected to the blows of a beater driven by a crank, or to the pounding action of falling stocks, which are lifted by cams or trips, as the case may be. In some cases acidulated water is used in the bed to facilitate the felting, but generally fullers' soap is used. The fulling of hat-bodies in the mill is confined to hats of wool. Fur hats are sized on the battery.

Following in due sequence of history, we cannot omit noticing the advent of Kossuth in the United States, which made soft hats and flowing beards fashionable. The demand for soft fur and wool hats increased very rapidly, but the latter could not compete with the former until *T. Waring* introduced the hat-finishing lathe. Before this time the wool hat-body, after it had been sized, was rubbed off with pum-

ice stoue, and afterwards put on a block to be ironed off and touched up with sand-paper. Waring made the hat-block with a chuck which fitted to a lathe spindle, and the operator, while the hat was revolving rapidly on the lathe, held sand or emery-paper on the hat, and thus finished the hat. The advances made in the manufacture of wool hats date from the introduction of this improvement. Prior to this time wool hats were made of the lowest grades, and could not compete with fur hats, but, by the use of the finishing lathe, it became possible to give hats made of the finer grades of wool a finish closely assimilating the appearance of the lower grades of fur hats, and from this time the wool-hat trade began to rival the fur trade. See HAT-FINISHING LATHE.

Shortly after the introduction of the finishing lathe, sewing-machines were first introduced to put the lining on the brim of the hat. See HAT-LINING SEWING-MACHINE.

Consequent upon this came the hat-sweat rolling machine, which turns the edge of the leather sweat-lining in order to prevent its marking or hurting the forehead.

Next in order came a machine, invented by Eickmeyer and improved by Judson, to make the hat-lining. The tip is secured upon a table having a round or oval motion, while another piece is put in a folding gage in such a way that the stitching will fasten the edge of the piece that forms the side-crown in a circular or oval line to the flat tip. Judson added to this a pair of rotary trimming shears, and arranged the turn-table upon a swinging lever

The pouncing machine, however, now finishes the insides of hats almost equal to the outsides, and crown-lining is almost discontinued in felt hats.

Another addition to the machinery in the manufacture of hats is that used to put the stiffening into the hat-bodies. To give the bodies a permanent shape, some stiffening material is generally put into the body; in the better class of hats a solution of shellac; in those of cheaper character, Irish moss, glue, etc. The solution is put into a trough under a pair of rollers which are geared together and driven by a belt from a line-shaft. Two troughs and two sets of rollers are generally mounted on one frame, one trough containing a thin solution into which the whole hat is plunged, and the surplus matter pressed out by passing up the hat-body between the rollers. The other trough contains a heavier solution into which is dipped that part only of the hat which is to form the brim. The troughs are heated by steam to keep the stiffening in a fluid state, and the hat-bodies, after being stiffened, are ready to be blocked.

Up to this time the hat-body is yet of a conical shape; *forming*, *hardening*, *fulling*, and *stiffening* have followed each other *seriatim;* this series is in the case of the wool hat-bodies only. It has been already explained that the operation with fur bodies is upon a special set of machines.

The blocking of the hat-body is that part of the manufacture in which the cone-shaped hat-body is pulled out around the edge to develop the brim, and the upper part is widened out to form the flat tip and the side crown. This is described under BLOCKING MACHINE, pp. 109. 110, *supra.*

The machine of Fenn may be described in brief to have had two pairs of rollers, one pair traveling somewhat faster than the other. The edge of the conical hat-body being nipped between the rollers, the pair in advance pulled upon it faster than it passed through the hind pair and so stretched it. It was thus gradually flattened out so as to form a brim, but did not act upon the crown or tip, and as its action was slow and incomplete it only came into partial use.

The first complete machine for stretching hat-bodies, wool or fur, was the corrugation stretcher of Eickemeyer, and these machines, in various modifications to suit the different kinds of work, are now used almost exclusively in the hat factories of this country. Described and illustrated under BLOCKING MACHINE (Fig. 335, p. 109, *supra*), it need not be considered at length here. It has a ribbed and recessed former which rises vertically and pushes the hat-body into a cap which has a number of yielding levers corresponding in number with the recesses in the former. The edge-rollers on the ends of the levers push the felt into the recesses of the former and stretch it. This is repeated again and again, the hat being moved on the former between each operation. The brim and tip are thus developed.

Next in order comes the blocking machine to make the *band*, as the sharp angle formed by the junction of the brim and side-crown is known in the trade. This is done by a rising spindle which carries the hat on its block, in the first place against a clamping plate which holds the brim flat and then pushes the crown into a cylindrical banding shell whose lower edge forms the *band* or angle. See BLOCKING MACHINE, Fig. 337, *et seq.*

To adapt the principle of stretching by corrugation to fur hats a number of modifications were required. It was found advantageous to separate the *brim stretcher* from the *tip stretcher*, and to substitute round-edged bars for the round-edged rollers.

These machines are considered in their places. See BRIM STRETCHER, Fig. 427, p. 135, *supra;* TIP STRETCHER, *infra.*

Eickemeyer's finishing blocking machine, known as a *hat-shaping machine*, is considered and illustrated under SHAPING MACHINE. The hat placed upon an expansible block (which has been previously contracted to its smallest diameter) and a circular series of 38 tongs is made to grasp $\frac{3}{8}$″ of the edge of the brim all round. The banding ring is thrown over the hat and locked fast. The edge of the brim being firmly held by the tongs, the operator raises the block and expands it to the desired size. The hat is then cooled and taken off, and the operation repeated on the next hat.

All the adjustments — size of band, height and diameter of crown, and width of brim — are made by gages attached to the different levers, so that the operator can set each part in a few moments, and all sizes of hats can be shaped on the same machine. A good operator will block from four to six dozen per hour. See SHAPING MACHINE.

The introduction of these machines for the stretching and blocking of hats has had a marked effect both upon the quality and facility of production of the hats so treated. When but imperfectly done, hats will in a short time lose their shape and "go to seed," as it is called in the trade, but when properly blocked on a machine, the felt is so well and equally stretched and shaped that the hat is much more durable.

Next in importance to the machine for blocking and shaping are the pouncing machines, for sand-papering the surface of the hat-body or the hat after it has been blocked.

The hat-finishing lathe, used in the wool-hat factories, was never successfully introduced in the fur-hat manufactories, owing to the fact that fur hats were usually made in small shops where power was not used, and also on account of the difference in the material.

The pouncing machines now in general use are constructed on two principles.

A rapidly rotating cutting or rubbing cylinder, which operates upon the hat-body or hat while it is fed along upon a yielding bed, is used in one class of machines. In the other class, a reciprocating motion is given to the cutting surfaces to rub in two directions.

For wool hats, and the lower grade of fur hats, the rotating cutter machines are exclusively used.

Under their own captions are described machines for pouncing hat-bodies, special machines for pouncing the brims, and for the crowns of the common grades of blocked hats, and also the reciprocating machine for the finer classes of felt hats. See POUNCING MACHINE.

The foregoing account comprises the most important machines used in the hat factories of the United States, but mention may be made of some machines used in the final finishing of the hat.

Joyce's hat-brushing machine is frequently used to remove the dust left in the hats by the pouncing machine.

Stewart's sewing-machine, adapted to sew ribbons on hats, has lately been extensively used in wool-hat factories.

Hydraulic presses to press hats into molds of proper shape, so extensively used in Europe, have not proved successful in this country, although a great many attempts have been made, and many machines patented by different inventors.

India-rubber blocks, made in the shape of the hat-block, have, however, been used in molds which surround the crowns only of the hats. See HAT PRESS.

Various styles of ironing machines are also in use, one of which is shown under IRONING MACHINE, which see.

But little improvement has been made in the finishing process of fur hats, and although many different machines have at times been used, and some with considerable success, none have been able to supersede hand labor. The use of the fulling mill to felt fur hats has also been frequently attempted, with but moderate success.

See: —

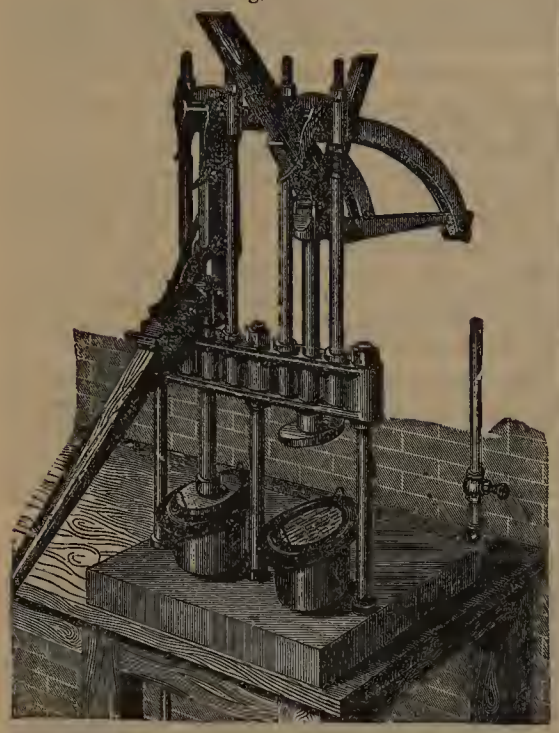
Rack, *Dorr* . . . . . * "*Scientific Amer.*," xxxvii. 360.
Felt . . . . . * "*Scientific American*," xl. 26.
Fireman's, *De Celis* . . * "*Scientific Amer.*," xxxviii. 407.
Forming machine . . . * *Laboulaye's* "*Dict.*," *etc.*, cap. "*Chapeau.*"
Making machinery . . * "*Scientific Amer.*," xxxiv., 50.
Press . . . . . * *Laboulaye's* "*Dict.*," iv., cap. "*Apprêts.*"
Sweat . . . . . "*Scientific American*," xlii. 3.
Hat-trade of America . . "*Scientific Amer. Sup.*," 2414.

Hat Press. A machine in which pressure is brought against the inside of the hat to cause the latter to expand while hot and soft against the inside of a mold of the required shape.

Hydrulic presses are used in Europe for this purpose, but have not proved so satisfactory in the United States for some reason.

India-rubber blocks, however, made in the shape of the hat, are used in molds which surround the hat-crown only. Fig. 1328 is *Osterheld & Eickemeyer's* machine for that purpose. Three wrought-iron columns which support a cross-head are fitted into a metallic bed-plate, which is hollow and is heated by steam. A mold of brass of suitable shape is

Fig. 1328.



Hat Press.

put under a plunger operated by a hand-lever. When the mold is heated to a certain degree a hat is put into the mold, and a rubber die provided with two handles is placed inside the hat. The plunger, which has an oval flange fitting the mold loosely, is now lowered and by means of a toggle lever, which presses against the upper cross-head, the rubber is compressed, and thus the hat pressed against the hot mold. In the illustration one hat is shown as under pressure while the other is ready to press down the lever. The hat is left in this position for from 3 to 5 minutes, and it has, when removed, a smooth and glossy finish.

Hat Sha'ping Ma-chine'. See SHAPING MACHINERY. Also Figs. 2438–2441, page 1078, "*Mech. Dict.*"

Hat Sha'ving Ma-chine'. See SHAVING MACHINE.

Hat Stif'fen-ing Ma-chine'. See STIFFENING MACHINE.

Hat Stretch'ing Ma-chine'. See BLOCKING MACHINE. Fig. 335, p. 109, *supra.*

Hat Sweat. That part of the lining of a hat which comes in contact with the head.

Ventilating, *Smith* . . . * "*Scientific American*," xlii. 5.
See HAT LINING SEWING-MACHINE, *supra.*

Haul'ing En'gine. An engine for drawing cars or loads in mines or on ways or inclined planes.

Underground, Engl. . . * "*Sc. Amer. Sup.*," 2373 ; * 2476.
Drum for traction engine.
Aveling & Porter, Br. . * "*Engineer*," xlviii 430.
For slips, *Hayward, Tyler & Co.*, Br. * "*Engineering*," xxiii. 362.
San Domingo mine, Spain * "*Engineer*," xlvii. 316, 321.
Horizontal, *Tangye*, Br. . * "*Engineer*," l. 103, 119.

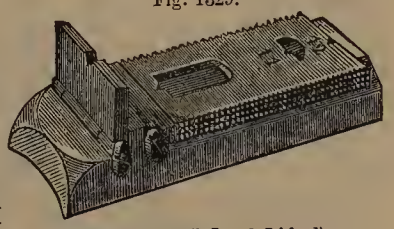
Haul Seine. (*Fishing.*) A long net depending from a cork line and leaded at its lower depending edge, used to sweep large areas of water. The ends of the land line are carried ashore and being hauled upon the beach, the net assumes a V-shaped form; the bag of the net in the bend is the last to come ashore. See also SEINE.

Haul-up' Gear. 1. A portion of the saw-mill machinery devoted to drawing logs up from the yard or bay to be sawn.

2. Capstan or other machinery for hauling in the seine. Used on the Chesapeake and Potomac.

Hausse. A lifting breech-sight of a gun.

Fig. 1329.



Hausse (*Small Leaf Lifted*).

Figs. 1329, 1330, 1331, show that of the Mauser rifle, the piece adopted by the German government. It is short and at the same time adapted for long range firing.

It comprehends the following dispositions and range : —

Nick on the breech, 200 meters.

The small rear leaf lifted (Fig. 1329), 300 m.

The small leaf folded down and the forward *hausse* raised: the bottom nick (Fig. 1330), 400 meters.

The slider raised so that its lower end corresponds with figure "5" on the left, 500 meters.

Slipping to mark "6," 600 meters.

And so on up to "10" (Fig 1331), 1,000 meters.

The sight then shifts to the upper opening in the slider, the latter being slipped down.

The bottom of the upper opening, 1,100 m.

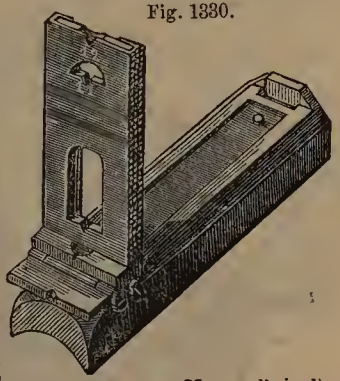
The top of the hausse, 1,200 meters.

The slider lifted to expose "13" on the right, 1,300 meters.

And so on up to "16" 1,600 meters, which is the position shown in Fig.1331, which is shown as set for 1,000 or 1,600 meters, by using the lower or the higher notch, for the respective distances.

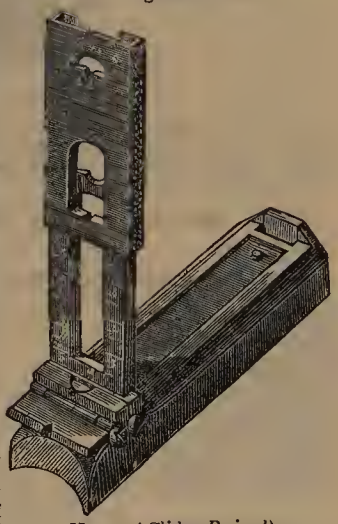
Other forms are given under SIGHT.

Fig. 1330.



Hausse (*Forward Hausse Raised*).

Fig. 1331.



Hausse (*Slider Raised*).

Haw'ser. A cable.

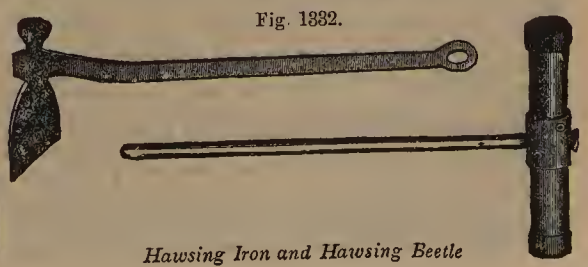
The steel hawsers of the large British ships of war are 8″ in circumference, doing the duty of hempen hawsers of 25″. 120 fathoms of 24″ hempen cable weighs 7 tons 16 cwt. 8″ wire cable 2.5 tons. The wire rope is equal in strength to a 2.5″ chain, the weight of which would be 16 tons.

Haw'ser Bend. (*Nautical.*) A kind of hitch shown at *l*, Fig. 2513, p. 1105, "*Mech. Dict.*"

Haw'ser Pipe. (*Nautical.*) A lining or bushing for a hawse-hole, through which passes the chain cable.

Haw'sing I'ron. A calking chisel.

Fig. 1332.



Hawsing Iron and Hawsing Beetle

Haw'sing Mal'let. A hawsing beetle used with chisels, known as *irons*, in driving oakum into seams. Fig. 1332.

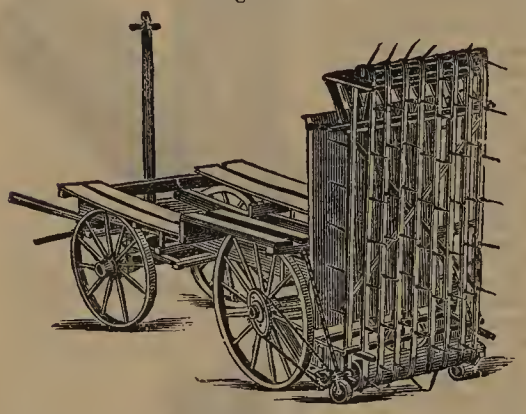
Hay Car'ri-er. A device used to suspend the horse hay-fork in a barn and travel along a bar to remove the load to a distant position, where it may be dropped. See Fig. 2449, p. 1081, "*Mech. Dict.*"

Hay Fork. (*Add.*) 3. A horse hay-fork for elevating large bunches of hay into a mow or on to a rick. See FORK, pp. 907, 908, "*Mech. Dict.*" HARPOON FORK, Fig. 2409, p. 1065, *Ibid.*

Hay Load'er. A rake with continuous elevator attached at the rear of a wagon and traveling along a windrow to load the hay on to the wagon. Foust's hay-loader is shown in Fig. 1333.

It has a wheeled frame attached by eye-holts to the wagon and having an incline on which contiuuously travels a slatted

Fig. 1333.



Hay Loader.

belt having prongs which gather the hay collected hy the rake. The helt is traversed by means of a sprocket wheel on the revolving axle of the trailing frame. See also Figs. 2456, 2458, p. 1083, "*Mech. Dict.*"

Hay Ma-chine'. See the following references: —

Dryer and curer, artific., *Gibbs*, Eng.	* "*Sc. Amer.*," xli. 358.
Elevator and carrier, *Smith* . . .	* "*Sc. Amer.*," xxxv. 67.
Fork, horse, *Chaffin*	* "*Sc. Amer.*," xxxv. 38.
Fork, *Harrison*	* "*Min. & Sc. Press*," xxxviii. 81.
Harpoon, *Grant*	* "*Sc. Am.*," xxxvi. 341.
Loading machine, *Loader*, Br. . .	* "*Eng'ing*," xxiv. 77.
Making machine. See HAY TEDDER.	
Press, *Dederick*	* "*Engineer*," xlvi. 91.
Press, *Dodge*, Pilter, Paris . . .	* "*Sc. Amer.*," xl. 371.
"*Hercules*," *Lever Jack Co.* . .	* "*Engineer*," xlvi. 91.
Hydraulic, Woolwich Dockyard, Br.	* "*Engineer*," xlvi. 461, 464.
Ricking App., *Hill*	* "*Sc. Am. Sup.*," 128.
Tedder, *Howard*	* "*Sc. Am.*," xxxiv. 150.
Reading Iron Works, Br. . . .	* "*Engineer*," xliii. 59.

Hay Ma'ker. 1. An apparatus invented by Gibbs, and used in England for curing hay in catchy weather. It consists of a stove, fan, and a chute, through which the grass passes to be dried.

"A portable stove made of plate iron is surmounted hy a fan, which is driven hy a belt from a three-horse power portable steam engine; the fans draw all the heated air and gases from the coke fire together with a volume of warmed air, which passes through a chamber surrounding the inner chamber of the stove, and hlows the hot current, at a temperature of 360° Fah or more, into the dryer. This resembles in general shape a straw elevator, consisting of a sheet-iron trough 6′ in hreadth, 20′ long, if mounted on wheels as a portable carriage, or 40′ or 50′ long, if a fixture. The trough is raised at one end at a low angle, so that hay fed in at the upper end furthest from the stove shall slowly travel to the lower end near the stove — this heing assisted hy a slow reciprocating motion given to the bottom of the trough. A ridge of triangular section running along the middle of the trough divides it into two almost semi-circular chanuels, so that the hay passes down in two streams; the hot air issues through two split apertures, one on each side the base of the middle ridge, and from the entire length of the machine; and the hay is kept continually stirred and lightened up over the hot blast hy a number of small iron stirrers cleverly contrived to imitate the action of forks worked hy hand."

2. A machine for stirring grass in the field, to expose it to sun and air. See HAY TEDDER, Fig. 2460, p. 1083, "*Mech. Dict.*," *et infra.*

Hay Press. The subject is considered under BALING PRESS, "*Mech. Dict.*," where the varieties are separately considered under captions derived from points of construction. See list under BALING PRESS, p. 218, *Ibid.* See also Fig. 183, p. 68, *supra.* Also *ration* press, Fig. 184, *Ibid.*

The hay presses of Dederick and Dodge make bales continuously, a compressed bale being tied and discharged while another is being formed.

The Dederick press has a plunger or piston, acting in connection with a reciprocating feeder, which drives a hunch of hay within the range of the plunger between each stroke of the latter.

In the Dodge machine the hay is thrown loosely on the feed-tahle or troughs in front of the press, whence iron teeth carry it right into the open mouth of the machine,

Fig. 1334.

Dodge Hay Press.

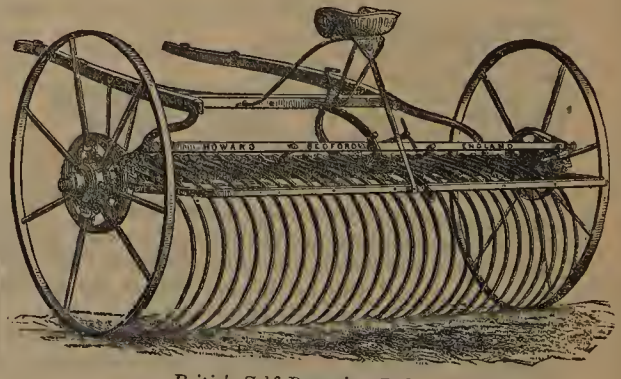
when it is seized by the revolving cones in the head-piece and drawn in from the feed-table in two continuous streams, and huilt up into a hale 26″ in diameter. The diameter of the hale is never increased, but the bale grows longer as layer after layer is huilt up. In doing this, the density of the hale is regulated by the friction-clutch, which has been previously made tight. After the hale is built such length as desired, the action of the compress-screw is hrought into play by simply shifting one cog-wheel, and in a few seconds the hale is compressed endwise and shortened from ahout one fourth to one fifth its length without increasing its diameter. While the compression is going on, the man attending the press is passing around and fastening the two wires. When this is done, the pressure is released, the bale dropped out, and the press set for another bale.

Hay Rake. Various forms are shown in Figs. 2453–2458, pp. 1082, 1083, "*Mech. Dict.*"

The additional figure (1335) represents the Howard self-dumping riding horse-rake (Br.).

The wheels are of wrought iron and the teeth of fluted steel. When used as a riding rake the load is dumped hy a foot-lever, which hrings a friction-hrake into action, causing the rake-head to make a portion of a revolution around

Fig. 1335.



British Self Dumping Raker.

the axle, tipping up the gang of rake-teeth and discharging the load. The clearer-rods, six in number, reach from the axle to the rear horizontal bar, on which the hind leg of the seat is supported.

When the operator is walking behind, the brake is operated by a hand-lever.

The self-dumping feature is also found in a large number of American horse hay-rakes, some of which use a clutch arraugement. In the French rake of Lhuillier, of Dijon, the same friction band is used, as just described.

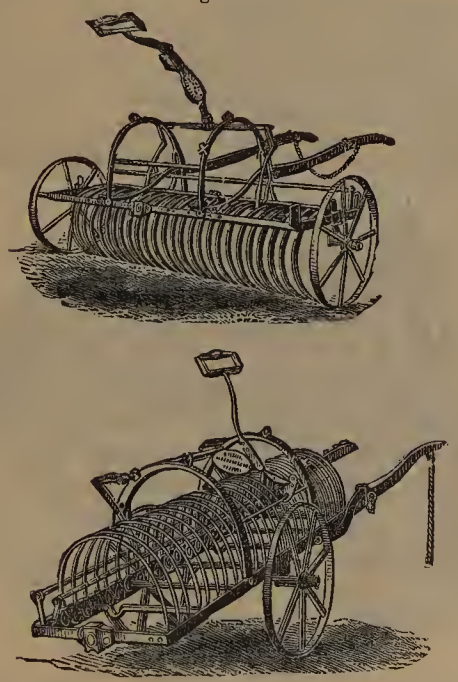
In some simple forms of American rakes the teeth are only operatable by hand lever, uot using the draft power of the horse to dump the load. In one, the teeth are independent, and may be set any distance from the ground by slipping them eudwise, each being held by its owu jam-screw. They are thus set up for gleauing and set down for meadow work. This also admits of drawing the end teeth forward of those in the center, so as to gather the hay inward and prevent its scattering out at the ends. The upper end of each tooth plays upon a spiral spring, which allows the point to rise and pass an obstruction. It is operated by hand and foot lever.

A turning rake on a wheeled axle is made in England. The discharge is made by pressing a foot-lever at the right of the seat, when the tooth-axle is disengaged and the loaded rake revolves to the rear, discharging the load. Having accomplished half a revolution, the foot being removed from the lever, the other rake is arrested at its working position and the work is resumed. The absence of shock as the rakes fall into position is particularly urged as an advantage.

In Francc is made a reversible rake, in which the length of the rake can be throwu in line with the shafts to enable the machine to pass narrow gateways aud doorways.

Fig. 1336 shows the two conditions.

Fig. 1336.



Reversible Rake.

Howard, Br. . . . . * "*Engineering*," xxvi. 471.
Reading Iron Co., Br. . . . * "*Engineer*," xlii. 113.
Coutrolling device, *Howard*, Br. * "*Engineering*," xxviii. 447.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, gives views aud descriptions of the following. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 160–163.

Steam reaper. *Areling & Porter*	England.
Horse rake. *C. Guilleux*	France.
Riding horse-rake. *Lhuillier*	France.
Self-dumping riding horse-rake. *Howard* .	England.
Walking hay-rake	England.
Turning rake. *Riches & Watts*	England.
Reversible horse-rake	England.
Hollingsworth horse-rake. *Dodd*	United States.
Double-acting hay-tedder. *Guilleux* . . .	France.
Hay tedder. *Howard*	England.

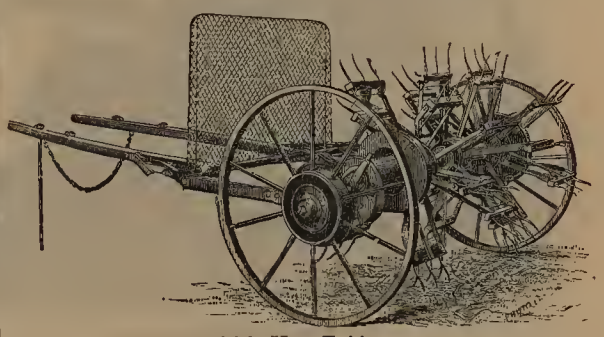
Hay Rope. Used in making large cores to wind about a core barrel before the application of loam. It permits the passage of the gases toward the perforated barrel, and as it carbonizes before the casting is cold, it facilitates the withdrawal of the barrel.

Hay Sweep. A form of rake for gathering hay, either from the windrow or the cock, to the place where it is to be stacked or ricked. It is quicker work than hauling by wagon, where the distance is small, and is used where hay is stacked in the meadow.

Hay Ted'der. An implement for stirring hay on the stubble to expose it to the sun and air and thus hasten curing.

Fig. 1337 shows the hay tedder built by Howard, of Bedford, Englaud; the forks are disposed in zigzag order, four

Fig. 1337.

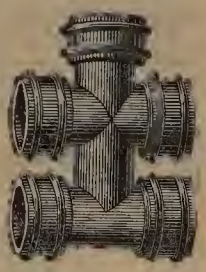


British Hay Tedder.

series of three teeth each, so that the work is practically uniform. The throwing in and out of gear is by means of a lever placed on the side out of danger of contact of the forks with the arm of the operator. The two systems of forks are regulated at such height from the ground as may suit the condition of the crop. The fork-heads revolve at a rapid rate, and the wire netting is to catch the hay and prevent it from covering the horse. By an eccentric movement of the main axle the rakes can be changed from a forward to a backward action, or *vice versa*.

Hay Un-load'er. A movable frame is placed on the wagon, and this is loaded in the field. Being drawn to the barn, tackles are secured to 4 eyebolts on the frame and the load elevated at one lift. When required to dump, the tackle at one side continues to lift, and so tips off the load.

Fig. 1338.



H-Branch.

Ha'zel Hoe. A grubbing hoe for working in brush and bushes.

H-Branch. A main or pipe coupling having the form of the letter H, as in Fig. 1338.

H-Drill. A rock-drill, Fig. 1339, with a central and two end portions, resembling in section the letter H.

Fig. 1339.

H-Drill.

Head. (*Founding.*) Over the thickest part of heavy castings, a large *flow-gate* or *riser*, for the metal, is placed. Through this the contracting mass below is *fed* from time to time with hot metal, while a boy keeps the head open with a *feeding* or *working* rod.

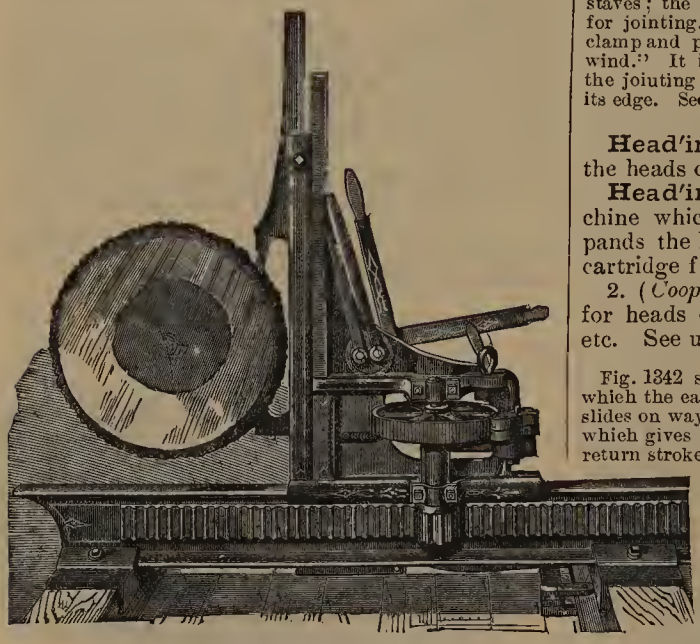
Head Axe. (*Whaling.*) For cutting off the head of the dead whale; opening the skull to obtain spermaceti; cutting off the baleen, etc.

Head Block. (*Saw-mill.*) A name which formerly signified the block which supported the head end of the log, while the tail-block supported the rear end.

Now, the device for holding the log upon the carriage while being sawn.

Gridley's head-block is shown in Fig. 1340. It exhibits a log hung up for sawing through and through, the boards being subsequently trimmed in the edger.

Fig. 1340.



Saw-mill Head-block.

Head-block. *Scofield* * "*Scientific American*," xxxviii. 291.

Head-block Plate. (*Carriage.*) An iron resting on the fore-axle and supporting the head block. It has projecting plates, one or two, for the attachment respectively of the single or double perch bars.

Head Dres'sing Ma-chine'. Used for leveling, facing, and smoothing barrel heads upon one side after the same have been jointed, doweled, and put together.

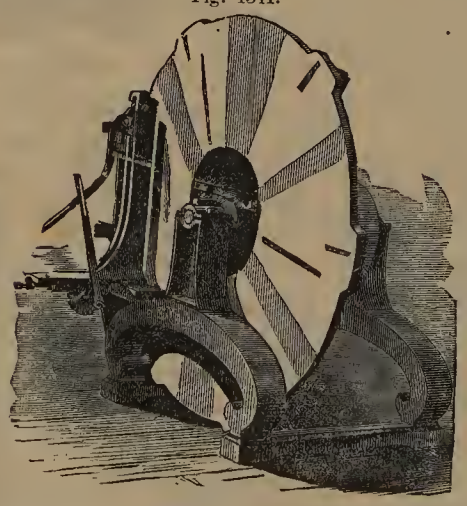
By passing the heads once through the machine they are fitted for the head rounder, and need no farther finishing. See Fig. 217, p. 77, *supra*.

Head Ear'ings. (*Nautical.*) The laniards to haul out the earings, which are ropes to fasten the upper corners of sails to their yards.

Head'ing. (*Mining.*) The vein above the drift.

Heading Chip'per. A machine for jointing head-staves. See HEADING JOINTER.

Fig. 1341.



Heading Jointer.

Head'ing Joint'er. A machine for planing the edges of pieces for heading.

On a heavy iron frame is mounted a large iron wheel in which are cutters for dressing and jointing the heading staves; the inner set of cutters for dressing and the outer for jointing. The piece of heading is locked in the sliding clamp and passed up to the cutters, which take it "out of wind." It is then taken from the clamp and placed upon the jointing rest, which gives a smooth and true surface to its edge. See also Fig. 218, p. 78, *supra*.

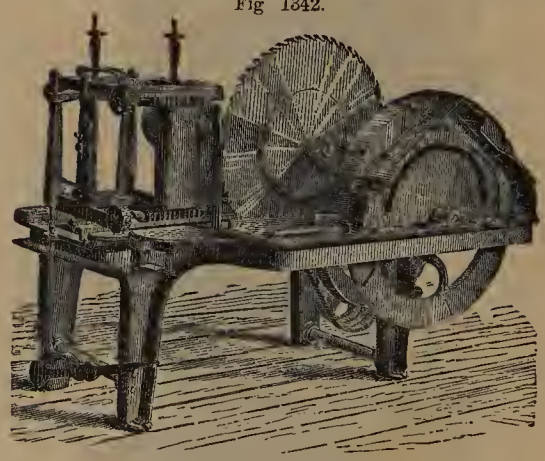
Head'ing Knife. (*Fishing.*) For cutting off the heads of halibut and other large fish.

Head'ing Ma-chine'. 1. (*Cartridge.*) A machine which presses the cartridge shell and expands the head to form a flange, which keeps the cartridge from slipping into the barrel.

2. (*Coopering.*) A machine for getting out stuff for heads of casks or barrels; dressing, turning, etc. See under various heads.

Fig. 1342 shows Lane's heading machine and jointer, in which the carriage, carrying the balk of wood to be sawn, slides on ways, and is moved by a compound crank motion, which gives a relatively slow forward motion and a quick return stroke. The feed works are driven by a single belt running from a cone pulley on the saw mandrel to a corresponding pulley on a countershaft carrying a paper friction pulley that in turn drives the iron friction pulley of the compound crank. The length of the stroke can be varied according to the width of the heading or shingles. The performance is 40 cuts per minute. The blocks are held in a perpendicular position and are set toward the saw between toothed rollers, the saw cutting into the side of the block. In front of the carriage is a round plate or table on which to rest the block while taking out the slab. Attached to this horizontal and partly revolving plate are the shipper handle, for starting and stopping the carriage, and an upright guard of wrought iron, that swings around in front of the saw whenever the carriage is at rest. The upper roll is raised by a treadle, enabling the operator to use both hands in taking out slabs and putting in new blocks. The saw mandrel is made of 2¼″ steel, with long bearings the full

Fig 1342.



Heading Machine.

size of the mandrel. The set rolls are adjustable to take in blocks from 11″ to 20″ long. The block is set while the carriage is moving about 1″ in passing the dead center. The iron box for catching the shingles is adjustable to the saw by screws and springs, so that should a splinter wedge between the saw and box, the box will spring away and let it pass through. A wheel-jointer, 40″ in diameter, is attached to the machine in such a position that the sawyer can stand at the saw and joint the shingles without turning his body. The jointer has two places for jointing, so that two persons can work at the same time, and it can be detached from the machine, and set in some other place, if desired. The jointer wheel is covered with an iron case, so as to prevent injury to the hands of workmen, and at the same time keep the shavings from flying.

Greenwood . . . . . * "*Man. & Builder*," xi. 55.
Dressing machine, *Holmes* . . * "*Engineer*," xli. 430.
Turner, *Holmes* . . . . . * "*Engineer*," xli. 431.
* "*Man. & Builder*," xi. 55.

Head'ing Pla'ner. 1. A machine for dressing down heads of casks, barrels, etc. See Fig. 217, p. 77, *supra*.

2. A small form of planing machine for dressing head staves, or made-up heading. See also STAVE DRESSER, p. 2314, "*Mech. Dict.*"

Head'ings. (*Mining.*) In placer mining, the mass of gravel above the head of the sluice.

Head'ing Saw. 1. A stave saw. One for sawing head staves from the log or bulk. See STAVE CUTTER, p. 2313, "*Mech. Dict.*"

Fig. 1343.

Head Light.

2. A saw for trimming heads to circular form. Fig. 219, p. 78, *supra.*

Head Knife. (*Whaling.*) For cutting off the head of the whale.

Head Light. In the locomotive head-light, Figs. 1343, 1344, the reflector, oil tank, burner, etc., rest on a revolving table of cast iron, and the engineer is enabled to clean both reflector and glass without removing the slide. The burner, being screwed to the oil chamber, can be removed without unsoldering and repairs made without sending the lamp to the shop.

Fig. 1344.

Locomotive Head Light.

Head Li'ning. (*Railway.*) The enameled ceiling-cloth of a car.

Head Ma-chin'e-ry. See HEADING MACHINE and cognate captions.

Head Rest. 1. (*Surgical.*) *a.* Used in torticollis, Fig. 6567, p. 2603, "*Mech. Dict.*" *b.* A tripod head-rest is used in post-mortem operations.

2. A support for the head on chairs used by dentists, photographers, barbers, etc.

Head Round'er. See BARREL-HEAD ROUNDER, Fig. 219, p. 78, *supra.*

Head Sheet. (*Nautical.*) A sail before the mast, or the foremast, in case of those vessels having more than one mast.

Head Spade. (*Whaling.*) Used in cutting off the head of the whale.

Head'stock. 1. That part of the lathe which carries the live spindle on which the work is chucked.

Fig. 1345 is offered as a specimen of good practice.

"The spindle *A A* is of hardened cast steel, ground perfectly cylindrical, *after having been hardened*, to avoid danger of change of form in the process of hardening, to secure absolute truth in size and shape, and to obtain perfect smoothness and the desired hardness. The box *B*, carrying this spindle, is subjected to all the strain thrown upon the latter, whether by the weight of the piece or by the force exerted by the tool. Here it is made of a single piece of steel, fitted approximately to finished size, hardened, and finally ground to exact form and to fit. The spindle bearing, *C C*, where it turns in the box, is conical, and capable of adjustment longitudinally, to take up the looseness occasioned by the wear, which takes place even with hardened steel journals running in hardened steel bearings. End-play is prevented by the nut *D D* and the set screw *E E*, which hold the spindle snugly in a position such that it may turn freely without either side or end-play. The back-end of the spindle is carried in the journal *F*, its box being held by the cap-screw *G G*. The cone-pulley *H H* turns loosely on the spindle when the back-gear is in action, and is clamped by the sliding-block *I* and screw *J*, when the spindle and the cone are to move together, the cone driving the gear *K K* directly, and the latter carrying the spindle, to which it is secured by keys. The pinion *L L*, on the cone-pulley, drives the back-gear. A spindle, *M M*, carried on the rear plate of the head-stock *N N*, carries the feed-cone pulley *O*. The belt-cone *H H* and the back-gearing are given broad bearings." — *Prof. Thurston.*

Fig. 1345.

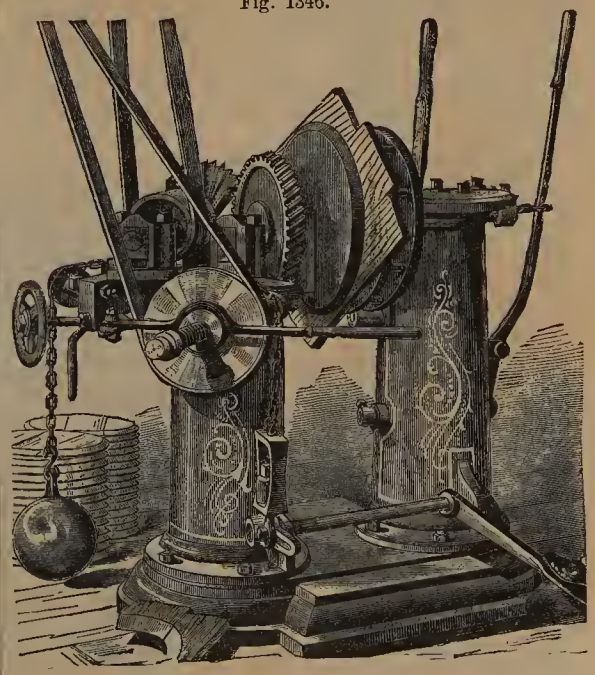
Lathe Spindle and Headstock. (*Worcester Free Institute.*)

2. (*Spinning.*) The stationary portion of a mule, containing the mechanism for effecting the different changes necessary in spinning. The other stationary portions are the creels for the bobbins and the rollers and roller-frames for reducing the thickness of sliver. See MULE.

Head Turn'er. A machine for rounding and beveling barrel-heads. Fig. 1346 shows a machine made by Holmes.

Before the unfinished head is put into the machine to be rounded, its center is found and marked by an apparatus for that purpose. When the head is put into the machine, the centering pin, which is jointed to the hand-lever beside the standard, is pushed forward by the use of the lever, and is brought in contact with the center mark on the head, thus centering it between two disks, one of which, that on the right in the illustration, is provided with a number of spring

Fig. 1346.



Cask-head Turning Machine.

pins near its periphery, which press the work against the opposite disk. The pin-disk is not connected with the driving machinery. Its spindle enters the standard on the right, in which is placed apparatus by means of which the disk is thrown forward and locked in that position, firmly holding the work. Through the rotation of the opposite disk, the pin-disk is also carried around, but for only one revolution, at the end of which stop-mechanism, in rear of the standard and not shown in the engraving, is actuated to unlock the clamp, so that the pin-disk springs back and allows the work to fall out. The disk on the left is rotated by mechanism by the driving pulley, which is thrown into or out of gear by the horizontal handle shown.

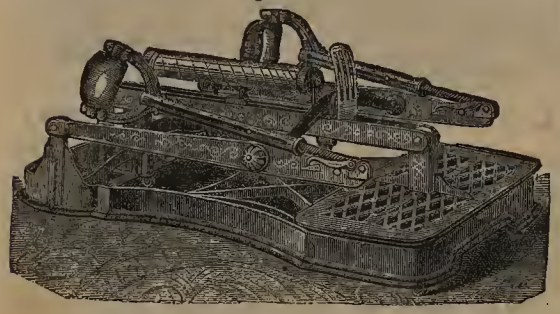
It will make round or oval heads. See also Fig. 219, p. 78, *supra*. A French form is shown at BARREL-HEAD TURNING AND BEVELING MACHINE. Fig. 220, p. 78, *supra*.

Health Lift. A machine in which the patient or exerciser lifts upon handles against a graduatable weight or spring.

It originated with Dr. Windship, who devised a system of graduated yoke-lifting. Several forms have been devised: the dead-weight center-lift, the side-lift or reactionary.

The *Mann* reactionary lifter, shown in Fig. 1347, is adjustable from a power of 20 lbs. to 1,200 lbs. The handles are at

Fig. 1347.



Reactionary Lifter.

the side, and fall down to secure compactness of the machine. It has a series of compound levers lifting against the weight of the operator.

The *Marsh* and *Knight* health-lifts have an elastic resistance which reaches its maximum at the end of the lift when the knees are about straight. See also Figs. 2939-2930, p. 1396, "*Mech. Dict.*"

Hearth. (*Metallurgy.*) 1. A form of furnace in which malleable iron is obtained by direct process from the ore. A form of BLOOMARY, which see.

2. An open hearth furnace in which pig iron is converted into malleable iron. The *open hearth* is in contradistinction to the reverberatory, which is domed in. The process in each is the same, it being to expose the melted iron to air to oxidize the silicon, manganese, carbon, phosphorus, sulphur, etc., present as impurities. In the hearth process the *blast* of air is driven upon the surface of the iron by inclined tuyeres in the side of the hearth, the iron gradually loses its impurities and is converted into a loup which is carried to the hammer or squeezer. The Walloon, Franche-Comté, and Lancashire are all modified forms of this idea.

3. The lowest part of a blast-furnace, generally cylindrical. It is lined with fire-brick, and the part below the tuyeres is the *crucible*, in which the iron and slag accumulate. The prolongation of the hearth towards the front of the furnace is the *fore-hearth*. The inclosure is the *dam*, covered by the *tymp-arch*. See Fig. 704, p. 293, "*Mech. Dict.*"

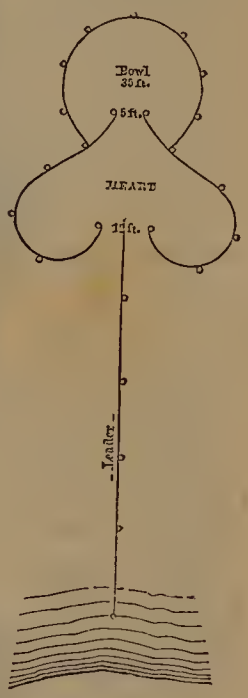
4. A form of steel furnace as distinct from the Bessemer convertor process. See OPEN-HEARTH FURNACE.

Heart. 1. (*Fishing.*) A net inclosure, into which fish are conducted by the leader, and from which they pass to an inner inclosure known as the *pound, bowl, pot,* etc. Fig. 1348. See POUND NET.

2. (*Nautical.*) A dead-eye with but one eye, and having scores for a lanyard.

Heart Net. (*Fishing.*) A net with a *leader* and a *bowl* or *pound*, between which is a heart-shaped funnel. See POUND NET.

Fig. 1348.



Heart Seine.

Heart Seine. (*Fishing.*) A species of seine, with a leader, heart, and pound secured by stakes so that the upper edge is floated at the surface and the lower touches bottom.

Heat'er. A name applied to a stove or furnace arranged to effect the warming by convection, as with warm air, steam, hot water.

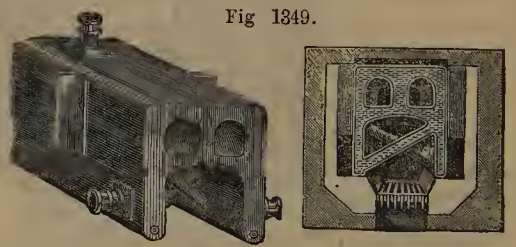
The *stove*, contrariwise, heats by radiation.

The term heater is a very inclusive one, and the subject is considered under various heads. See the list under HEATING AND LIGHTING APPLIANCES, p. 1309, and also STOVE. pp. 2409, 2410, "*Mech. Dict.*" Also list, p. 453, *infra*.

See also MAGAZINE STOVE, Figs. 5914-5922, p. 2411, "*Mech. Dict.*," and VENTILATING STOVE, Fig. 5909, p. 2410, *Ibid.*

The French furnace shown in Fig. 1349 is designed for domestic purposes and for conservatories, to be heated by circulation of hot-water pipes. The boiler is in rolled sheet-metal with riveted joints, and contains

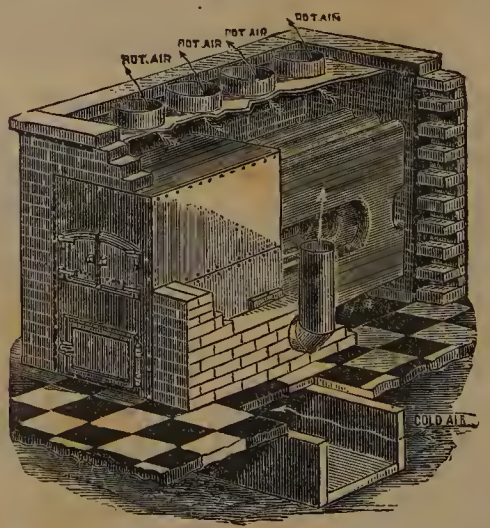
Fig 1349.



French Green-house Heater.

the furnace, ash-pit, water-legs, and the longitudinal return flues. The boiler is in a brick structure, a space be-

Fig. 1350.



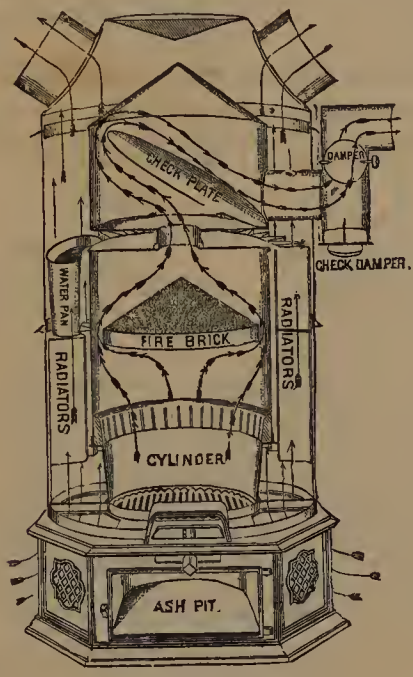
"Simplex" Hot-air Heater.

tween the two forming the re-return flue to the chimney. The water connections are shown in the perspective view.

Fig. 1350 shows Chase's "Simplex" furnace, in which the heating surface is a rectangular box, made of sheet-iron 1-10″ thick, and riveted. Its size for domestic purposes is 50 × 33″, height 52″ and heating surface 83 square feet. The top and bottom are of single plates, bent so as to rivet to the side sheets. The fire-box occupies a position in the boiler, being lined with fire-tiles, and so supported as not to touch the heating surface.

Fig. 1351 is a sectional view of what is known as a portable heater, from the fact that it is removable as a whole,

Fig. 1351.



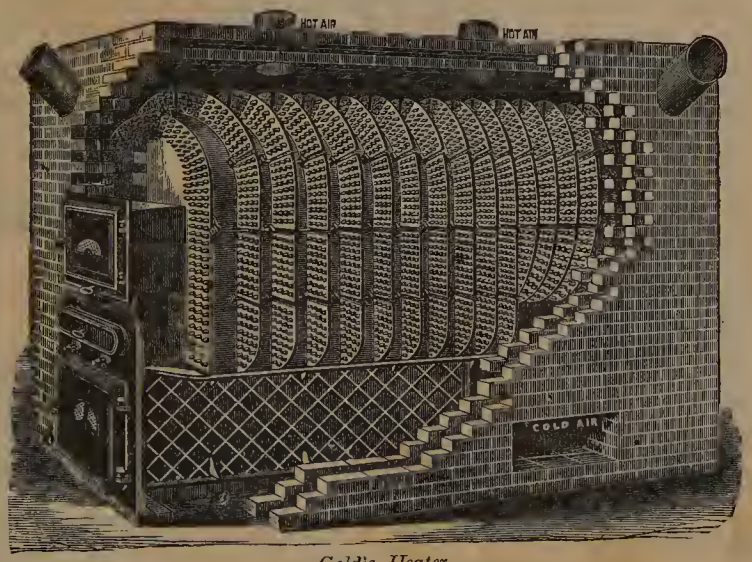
Air-tight Heater.

the brick ercetion forming no part of the arrangement. It has a riveted sheet-metal case.

The various parts are indicated in the figure. The flame spreads around a fire-brick which is suspended over the fire, passing through a ⅜″ space; thence to the radiator over the fire-brick, a check-plate causing it to make the circuit of the chamber before exit. Between the outer casing and the body of the heater is an annular space with corrugated lining, against which impinges the upward current of air, which is heated by contact therewith.

Fig 1352 shows Gold's heater, which has a riveted plate-

Fig. 1352.



Gold's Heater.

iron cylinder covered with points which greatly increase the radiating surface. Around it is a chamber of brick, inside of which and around the stove the air circulates.

Heat'er Cock. See JET VALVE.

Heat'er Coil. A prolonged pipe containing steam or hot water, and conducted through apartments or passages to heat them.

Coils assume many different shapes. A list may be found at COIL, on p. 207, *supra*.

Heat'ing and Light'ing. See under the following heads: —

Aërial-light apparatus.
Albo-carbon light.
Aphlogistic light.
Arch.
Arch bar.
Base burner.
Bath.
Bath heater.
Bath stove.
Blast gas-furnace.
Blast lamp.
Bleachery boiler.
Box coil.
Brazier's hearth.
Broiler.
Broiling oven.
Bunsen burner.
Bunsen lamp.
Burner.
Bye-pass.
Camp stove.
Candle.
Caudle lamp.
Candle machine.
Carbonic acid gas apparatus.
Carbouizing apparatus.
Car heater.
Car warmer.
Casserole.
Cauldron.
Charcoal furnace.
Clam baker.
Clay heater.
Coffee roaster.
Coil (varieties, see list).
Coil heater.
Coil plate.
Coil screen.
Coil stand.
Coke stove.
Condeusing coil.
Cooking stove.
Corrugated boiler.
Cottage range.
Cremation furnace.
Dead plate.
Dessicator.
Disinfecting stove.
Double cone coil.
Double cone lamp.
Double cone reflector.
Double lens lantern.
Double steam kettle.
Drip pan.
Dryer.
Drying closet.
Drying machine.
Dual burner.
Dutch oven.
Evaporator.
Expansion hanger.
Exsiccator.
Feed door.
Fighting lantern.
Fire front.
Fire-place heater.
Fire pot.
Flambeaulet.
Flameless lamp.
Flash light.
Flat coil.
Flat square coil.
Float lamp.
Food-cooking apparatus.
Foot rail.
Foot warmer.
Fresnel lamp.
Fresnel lens.
Fruit dryer.
Frying pan.
Gas absorber.
Gasalier.
Gas analyzer.
Gas and coke furnace
Gas burner.
Gas burner regulator.
Gas fitter's torch.
Gas furnace.
Gas grate.
Gas heater.
Gas lantern.
Gas lighter.
Gas-light governor.
Gas-lighting torch.
Gas oven.
Gas range.
Gas stove.
Glue heater.
Glue-melting apparatus.
Grain dryer.
Grate ring.
Grate shaker.
Greenhouse boiler.
Greenhouse furnace.
Grate
Grate bar.
Grid.
Heater.
Heater coil.
Heating apparatus.
Heating drum.
Heating furnace.
Heating stove.
Helical tank-coil.
Hinge burner.
Hook plate.
Horse-car heating.
Hot-air stove.
Hot plate.
Hot-water furnace.
Hot-water heater.
Hour-glass coil.
Illumination.
Inverted arch bar.
Intensive gas burner.
Ironing stove.
Jeweler's forge.
Kerosene stove.
Kettle.
Laboratory forge.

Laboratory furnace.
Lamp.
Lamp furnace.
Lamp stove.
Lantern.
Laundry apparatus
Laundry boiler.
Laundry stove.
Lime light.
Lumber dryer.
Magazine stove.
Magnesium light.
Manifold.
Mast-head lamp.
Mechanical lamp.
Oil stove.
Oven.
Oxycarbon submarine lamp.
Oyster range.
Paint burner.
Paper carbon-lamp.
Parachute light.
Peat charcoal kiln.
Petroleum burner.
Petroleum stove.
Pipe roller.
Pipe-roller stand.
Pipe stand.
Plumber's furnace.
Poke hole.
Porcelain stove.
Quadriform group-flashing light.
Radiator.
Radiator attachments.
Range.
Reading lamp.
Reel oven.
Reflecting lamp.
Register.
Register face.
Reservoir stove.
Return bend.
Ribbed boiler.
Ring plate.
Ring-top furnace.
Rocking-bar.
Rose gas-burner.
Safety lamp.
Screen.
Screw burner.
Service box.
Shaker.
Signal lamp.
Signal lantern.
Siphon lamp.
Smoke-house stove.
Smoothing-iron heater.
Soap coil.
Solaire.
Solar-heat apparatus.
Soup boiler.
Spiral tank coil.
Spring burner.
Square tank coil.
Steam cooking apparatus.
Steam heater.
Stock boiler.
Stove.
Stove-pipe ventilator.
Street lamp.
Submarine lamp.
Sun burner.
Tank boiler.
Tank coil.
Tea kettle.
Tempering gas heater.
Thawing apparatus.
Thermo-refrigerant.
Tinman's stove.
Toaster.
Tri-colored lantern.
Trunnion coil.
Tuyere coil.
'Tween-deck lamp.
Tymp coil.
Urn.
Valve manifold.
Vapor burner.
Vapor lamp.
Vegetable boiler.
Velocipede light.
Ventilating jack.
Vertical lamp.
Vertical tube coil.
Washing boiler.
Water-heating apparatus.
Wine heater.

Heat'ing Ap'pa-ra'tus. It has been proposed to supply heat to domiciles and factories by mains and pipes, as in the manner familiar with water and gas.

The following is the proposition, now in course of fulfillment: —

From the central station the mains will run through every street. One line of iron pipes from 3″ to 6″ in diameter, placed about 3′ below the pavement, packed around with some non-conducting material and inclosed in a wooden box, will be the conducting mains from which the hot water will be carried by means of smaller iron pipes, ½″ to 1″ in diameter, into the houses. Auxiliary or return pipes of about the same size as the conducting mains, will be laid alongside, through which the water, after it has passed through the houses, will run back to the reservoir.

The water heated in the reservoir to from 350° to 400° Fah., will be forced out through the conducting mains, and through the pipes which connect with the houses, and to each connecting pipe will be attached a water meter. The return pipe will also be provided with a water meter. Each house is to be provided with a steam convertor, which in general terms is simply a small metal chamber inclosed in a larger chamber. The water leaves the reservoir at about 400° Fah, and as soon as it enters the inner chamber it will expand into steam. The chamber is so constructed that a pressure of ten pounds will close a valve and shut off the supply of water. The steam will force its way through a valve into the outer chamber, whence it can be conducted through steam pipes to any part of the house and used for heating, cooking, or power, and returned through the auxiliary pipe back to the reservoir.

The steam cooking ovens are coils of pipe through which the steam passes inside of the ovens. Some of the steam will be condensed in the bottom of the convertor, and can be drawn off and used as hot water.

The system as pursued by Holly has an expansion junction service-box at intervals of 100′ to 200′ to provide for contraction and expansion of the mains, and from this box service-pipes are carried to the houses to be heated. A regulator is at each house and the steam used by each consumer makes its own record upon a slip of paper moved by the clock-work of the meter. The pencil-mark denotes the quantity of steam used, and the time of day at which each radiator in the house was put on or off.

Refer to: —

Hand warmer . . . . . * "*Sc. American*," xxxvii. 278
Hot water, *Abbott* . . . . * "*Manuf. & Builder*," ix. 57.
For small articles.
Bouchacourt, Fr. . . . . * "*Engineer*," xliii. 250.
Heater, *Gold* . . . . . * "*Man. & Builder*," xii. 283.
Hot water . . . . . * "*Sc. Am. Sup.*," 2713.
Hot water, *Hearn*, Engl. . . "*Sc. American*," xxxix. 227.
For cities, *Holly* . . . . "*Iron Age*," xix., Mar. 1, p. 1.
* "*Sc. American*," xli. 114.
For boiler makers, *Hewson & Wilson*, Br. . . . . * "*Engineering*," xxviii. 358.
Stove, *Lent*, Ger. . . . . * "*Engineer*," l. 244.
Stove, *Nott* . . . . . * "*Iron Age*," xix., Feb. 1, p. 3.
For drying chambers, *Pottier*, Br. . . . . * "*Engineer*," xlii. 357.
For cities, N. Y., *Spinola* . . * "*Iron Age*," xxiii., June 26, p. 15.
Heat Equivalent apparatus . * *Puluj*, "*Sc. Am. Sup.*," 204.

Laboulaye's "*Dict. des Arts et Manuf.*," ed. 1877, tome iv., article "*Equivalent de la Chaleur.*" Apparatus of

Hirn. Laboulaye.
Joule. Tresca.
Laws of Mariotte and Gay Lussac.

Heat measure, Radiant, *Ericsson.* * "*Van Nostr. Eng. Mag.*," xiv. 193.
Heat meter, *Holly* . . . . * "*Sc. American*," xli. 114.
Heat regulator, *Holly* . . . * "*Sc. American*," xli. 114.

Stove. Development of modern stove. Paper by Azel Ames, Jr., Report of Group XIV., "*Centennial Reports*," vol. v.

Heat'ing Fur'nace. The term *heating* furnace may be held to include the whole range of furnaces, a list of which is given on page 926, "*Mech. Dict.*," and another, p. 362, *supra.*

The *Gas-producing furnace* and *Regenerator Furnace* have usually features in common, although the regenerator is not a necessary concomitant of the method of using the fuel shown in Gas-generating Furnace, pp. 384-388, *supra.*

See also Heater, and list under Heating Apparatus.

Heat'ing Pan. (*Oil.*) A pan for heating flax or other seed which yields oil by expression.

The pan has a steam bottom for heating by steam. Horizontal stirrers driven by vertical shafts, and balanced so that they can be lifted clear for charging or discharging, keep the charge continually stirred. A gate is provided to each pan, through which the charge is drawn. The seed, after having been heated, is filled into bags, which are placed separately between horse-hair bags, covered with leather. The same kind of bags and hair are used whether the oil is expressed by stampers, screws, or hydraulic presses.

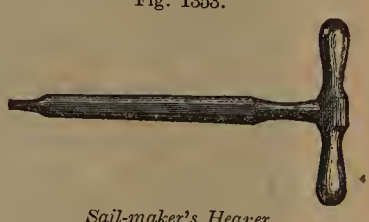
Other forms of pans for use in various other industries: sugar, confections, etc., are found under their appropriate heads in the "*Mech. Dict.*," and herein. See Evaporating Pan; Confection Pan; Vacuum Pan; Clay Heater; Dessicator; Drip Pan; Fruit Dryer, etc.

Hea'ton Steel. (*Metallurgy.*) Steel produced by air-blast through molten pig-iron; crude nitrate of soda, with other material, being used. See p. 2365, "*Mech. Dict.*"

Hea'ver. 1. A bar used as a lever.

2. (*Nautical.*) The tool, Fig. 1353, used by the sail-maker and sailor in marling, serving, etc.

Fig. 1353.



Sail-maker's Heaver.

Hec'to-graph. A process of dry-copying of writings or plans by reversing the freshly-written copy upon a gelatine film and subsequently applying clear sheets *seriatim* to the gelatine. See Copygraph; Copying Pencil; and Gelatine Process, *supra.*

Hed'dles. The cords governing the disposition of the warp-threads in the tissue.

See, for disposition of heddles and harness for various kinds of weaving, article "*Tissage*," *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," iii., ed. 1877.

Hedge Cut'ter. A hedge pruner. See Fig. 2479, p. 1093, "*Mech. Dict.*"

Hornsby, Eng. . . . * "*Paris Exposition Reports*," v. 239.
Walker, Br. . . . . * "*Engineer*, xlvi. 22.
Hedge knife . . . . Fig. 2483, p. 1093, "*Mech. Dict.*"

Heel At-tach'ing Ma-chine'. A machine for forcing on and securing heels to shoes or boots by pressure. — *McKay.*

Heel Build'ing Ma-chine'. A machine in which are associated, and compressed while being tacked, the lifts which form the heel.

Heel Ma-chine'. See nnder boot, shoc, sole, heel, etc., and other captions.

Machinery, *Bigelow* . * "*Thurston's Vienna Rep.*," iii. 309–318.
Stiffener, *Lyon* . . . * "*Iron Age*," xxii., Dec. 26, p. 1.
Cleaning machine . . "*English Mechanic.*"
Kent, Br. . . . . "*Scientific American Sup.*," 660.
Heel-spring, *Pease* . * "*Scientific American*," xl. 86.

Heel Plate. (*Fire-arm.*) The solid or skeleton plate at the butt-end of the stock. Sometimes the top and bottom are merely tipped.

Hel'i-cal Nee'dle. (*Surgical.*) A needle with a helically twisted stem to introdnce a ligature around an artery or in case of ruptured perineum.

Hel'i-cal Tank Coil. A steam or hot-water heating coil of helical or flat-spiral form.

He'li-o-gra'vure. The systems of heliogravnre, or sun-engraving upon copper, as employed in the Austrian Military Geographical Institute, are thus referred to in *Petermann's "Mittheilungen"*: —

"The sheets of the new Austrian Ordnance map are carefully drawn on paper, on a scale of 1: 60,000. They are then reduced photographically to a scale of 1: 75,000, transferred upon copper, touched up, and printed. In this manner each sheet of the map can be produced in nine months, while the same amount of work engraved in the usual manner requires nearly 46 months for its completion. The whole of the Austrian staff map, consisting of 715 sheets, will thus be completed in 10, 11, or 12 years. No less than 271 have been published since 1874. The advantages of this process, as regards cost and rapidity of publication, are evident, and they fully compensate for any slight inferiority in the appearance of the work."

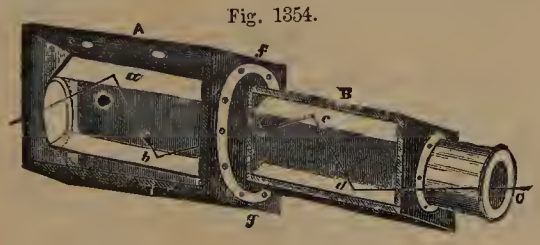
See also HELIOTYPE, p. 1097, "*Mech. Dict.*"

He'li-o-scope. An instrument for viewing the sun.

The instrument shown in Fig. 1354 is the invention of Herr Merz, of Mnnich.

It is based on the law of polarization of light. If a ray of light strikes at an angle of 35° 25′ on a mirror which is mounted so that it may be turned on its axis, and the reflected ray is thrown on a second mirror placed at right angles to the first, the light is polarized. The polarized ray is perfectly bright if the two mirrors are parallel, but it becomes more and more faint when the upper mirror is turned, until at a right angle it disappears altogether, so that the field of vision in the second mirror is perfectly dark.

Fig. 1354.



Merz Helioscope.

In the two cases, *A* and *B* of the apparatus, are mounted four heavy mirror glasses, *a*, *b*, *c*, and *d*. The case *A* is screwed to the teleseope through which the sun is to be observed. The light falls on the first mirror at an angle of 35° 25′, and is reflected to the second, from whence, by meaus of the mirrors *c* and *d* iu the ease *B*, it reaches the eye of the observer at *C*.

To effect the necessary diminution of the sun's light, the ease *B* is arranged so that it may be turned around the axis of the apparatus by the ring *f g*. When the mirrors in ease *B* are parallel to those in *A*, the image of the sun appears perfeetly white, but the light can easily be diminished to any desired degree by simply turning the case *B*, which can be doue without removing the eye from the ocular lens.

To prevent the air in the apparatus from becoming heated too much, the upper side of the ease *A* is provided with a couple of holes for ventilation.

A simpler arrangement by Dr. Van der Weyde is described by him as follows: —

"I take a piece of plate glass of the same width as the diameter of the objective, and about three times as long, ground at the back so as to destroy the exterior reflection of that surface, and coat it with black varnish. I attach this before the objective under an angle of 35° 25′ with the axis of the telescope, so that the solar rays entering the instrument are polarized by the reflection of the polished surface. To the eye-piece I simply attach as analyzer a Nicol prism, and by turning the latter round its axis I reduce the intensity of the solar light to any degree desired."

Refer to "*Scientific American*," *xxxviii. 163, 186; xlii. 389.

He'li-o-tel'lus. An orrery embracing the sun and earth in its scheme. — *Hommatt.*

See also GEOSCOPE; ORRERY; COSMOSCOPE, etc.

He'li-o-trope. A geodetical instrument used to reflect a ray of light to a distant station. First adopted in surveying about 1821, by Gauss, a Hanoverian, for the purpose of rendering the vertices of the triangles visible in the triangulation of the kingdom of Hanover. Capt. Drummond's heliostat was nsed in the ordnance survey of Great Britain.

As now used, it is a stand bearing a 10″ mirror, swung like the ordinary toilet looking-glass, except that besides swinging horizontally, it is also pivoted, so as to move vertically as well. Behind the mirror, in the very center, a little of the quicksilver has been removed, so that the observer can go behind his instrument and look through a tiny hole in it toward the station he desires to signal. Having sighted the station by adjusting the mirror, he next proceeds to set up in front of the heliotrope a rod, and upon this rod is a movable stud. This stud is manipulated like the foresight of a rifle, and the observer, again standing behind his instrument, directs the adjustment of this stud until the hole in the mirror, the stud, and the distant station are in a line. The heliotrope is then ready to work, and in order to flash signals so that they can be seen at a distance, the operator takes care that his mirror reflects the sunshine on the stud just in front of him. Such signals are visible from 30, 50, to 100 miles, according to circumstances of elevation, atmosphere, etc.

In another and simple form, two opaque screens are placed about 18″ apart upon a strip of wood forming a base, and screwed or nailed fast. A hole about 1″ in diameter should be cut through each screen, the one in rear being a little larger than the other, and across each there should be drawn two fine wires or threads, so as to intersect each other. About 6″ in rear of the screens there should be placed a small mirror — 3″ in diameter would be sufficient — so mounted as to have the two motions horizontal (or in azimuth) and vertical (or in altitude). The crude instrument is then ready for operation. To throw the ray upon any given object visible to the unaided eye, turn the mirror down out of the way or remove it altogether, and sight across the wires, moving the base until the line joining the intersections of the cross wires passes through the object. Then replace the mirror carefully, so as not to disturb the line of sight, and turn it in either or both directions until the shadow of the edge of the hole in the first screen is concentric with that in the second. The reflected ray will then be visible to an observer at the given point. — *Haupt.*

The *heliotrope* is known to the British military world as the *heliograph*, which is a misnomer. The word *'trope* is the more appropriate, as it *turns* to the sun like the *helianthus* and the pretty little *heliotrope* (*H. peruvianum*) — called also *turnsole* or *girasole* — are supposed to.

The word *heliograph* and its cognate *heliogravure* have reference to writing or drawing. The word *heliometer* has its use also, indicated by the termination. The word *heliostat* has also its specific meaning, which is true of each of the following: —

'graph.	'scope.	'trope.
'meter.	'stat.	'type.

The apparatus used with the British army is known as *Mance's* heliograph.

"The signals made by it, under favorable conditions of position and atmosphere, have been read as far as 80 or 100 miles. It cousists of a specially prepared mirror, with ingeniously-constructed adjusted mechanism for reflecting the sun's rays with absolute precision to any required spot, notwithstanding the sun's apparent movement. By the pressure of a fiuger-key the flashes are made of short or long duration, thus adapting the instrument to the Morse code of telegraphy. A second mirror is provided to permit of signaling being carried on irrespective of the sun's position. The instrumeut iutended for field service weighs from 6 lbs. to 8 lbs., and is mounted on a light tripod stand. The working parts are protected from injury during trausit, and the complcte apparatus admits of being easily carried, as it is also cfficiently worked, by one man.

"The apparatus has been in use for some time in India, where its working has been attended with very great success. Iu the winter of 1877-78 the Jowaki-Afridi expedition gave the Indian Government an opportunity of submitting it to the test of war. The two columns, uuder General Keyes and General Ross, operating in the Afridi hills were supplied with volunteer signalers. The instrumeuts were simply invaluable, and helio[tropes] were supplied to cach division of the subsequent Afghan expedition With Gen. Donald Stewart's column telegraphic communication was maintained by means of these instruments from the Khojak Pass to Girishk. General Roberts, from Khost, flashed his messages to the fort at Bannu, a distance of 60 miles; while Sir Samuel Browne, from tbe heights above Ali-Masjid, announced the capture of that fort to the expectant garrison of Peshawur by meaus of the Mance helio[trope]." — London "*Times.*"

Permanent heliotrope stations are now established between Tangier, Tarifa, Ceuta, and Algeçiras, and between certain W. I. Islauds. It is used iu the armies of the United States, France, and Belgium.

Refer to: —

Heliograph, *Anderson*, Br. * "*Engineering*," xxx. 221.
Heliograph, poeket, *Maj.* * "*Scientific American Sup.*," 4106.
Macgregor.
Heliometer, *Anderson* . * "*Scientific American Sup.*," 4030.
Heliograph, *Wynne* . . "*Van Nostr. Mag.*," xxiii. 479.
Lesuerre . . . . . * "*Jour. Soc. Teleg. Eng.*," vii. 351.
Mirror telegraph . . . "*Sc. American*," xxxix. 310.

He'lix. (*Electricity.*) The coil. In elcctromagnetic or induction machines the helix is composed of two or more coils. The inner or primary coil being of coarse wire and connected direct with the battery, and the outer or secondary coil being finer wire wound upon but completely insulated from the primary coil, and receiving its electric influences by induction from the core and inner coil.

Help'er Ring. A ring on the edge of a street-car platform for the attachment of the hook of the single-tree of the *helper horse* during the ascent of a grade.

Hem'a-cite. Bullock's blood mixed with finely comminuted mineral and vegetable substances; dried, molded under pressure, varnished. Uses for knobs and ornamental articles. — *Dibble.*

See Bois-durci, "*Mech. Dict.*," p. 320, and list of Compositions, p. 212, *supra.*

"*Iron Age*" . . . . . xxiii., Feb. 20, p 9.

Hem'i-ple'gi-a Ap'pa-ra'tus. (*Surgical.*) Supporting apparatus for a partially-paralyzed limb. *Paraplegia*, for both limbs.

Page 34, Part IV., *Tiemann's* "*Armam. Chirurgicum.*"

Hem'i-plun'ger. A proposed form of sea-going vessel, in which the habitable or fighting portion is supported by posts upon au cutirely submerged portion, which is supposed to be below the level of wave-agitated water.

Tomassi, Paris . . * "*Scientific American*," xxxvi. 115.

Hem'or-rhage In'stru-ments. (*Surgical.*) Acting to prevent effusion of blood. The term may include epistaxis instruments, compresses, tourniquets, hydro-hemostats, ligating instruments, etc.

Bates's instrument for arresting urethral hemorrhage after operation consists of a thin, soft rubber pouch, ¾″ wide, and 8″ long. The outer end has three openings, two of which are furnished with stop-cocks. The center is traversed by a gum elastic catheter, the end of which, after piercing the lower extremity of the pouch, is fastened, and then cut off; over which part of a soft rubber catheter is passed and secured. A stylet passes through the catheter, and renders introduction easy. The apparatus measures 25 mm. in its flaccid state, and admits of any desired distention. It is used as follows: After the division of the strictures, the instrument is introduced so that the end of the catheter rests in the bladder, or just outside, if preferred; the stylet is then withdrawn and a plug inserted in the end of the catheter. The instrument is then tied in. To one stop-cock is attached a fountain syringe; to the other is attached rubber tubing for the purpose of conducting the refuse water to a receptacle at the bedside.

Hem'or-rheu'mo-scope. (*Surgical.*) An instrument for observing the flow of blood in a vein. The bowl of the instrument resting firmly upon the trunk of a superficial vein the peculiar movement of the stream of blood beneath the bowl sets the sensitive fluid column within the graduated tube into sympathetic action.

Fig. 282, Part I., *Tiemann's* "*Armam. Chirurgicum.*"

Hem'or-rhoid'al Clamp. (*Surgical.*) An invention in which a clamp is combined with a cautery. The invention of *Amusat.*

Shown in Fig. 579, p. 121, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Other pile-clamps are shown in Figs. 567-568, *Ibid.*

Hem'or-rhoid'al In'stru-ments. (*Surgical.*) These consist of clamp, syringe, dilator, tenaculum, artery and needle forceps, insufflator, cautery, bistoury-caché, suppositories, etc. See under the various heads.

Hem'or-rhoid'al Syr'inge. A fine, puncturing syringe, with graduated glass barrel, like a hypodermic syringe, for introducing medicaments to suppress hemorrhoids.

See Fig. 622, p. 123, Part III., *Tiemann's* "*Armamentarium Chirurgicum.*"

Hem'o-stat'ic In'stru-ments. (*Surgical.*) Those acting as styptics to prevent effusion of blood. See Epistaxis Instrument; Hydro-hemostat, etc.

Hemp Knife. A hooking knife, shaped like a pruner, and having a long handle so as to reach the lower portion of the stalk without stooping.

Hemp Sof'ten-ing Ma-chine'. A hemp brake, operating upon the rotted and subsequently dried stalks. One made recently by the Mohawk & Hudson Manufac. Co. has two fluted rolls: the lower one is 12″ in diameter and 6′ long. The upper one is 24″ by 6′. The lower one is driven by gearing from the back shaft, and in turn it drives the upper. The shafts are 6″ in diameter. The upper roll and shaft weighed about 8,500 lbs., and the complete machine about 15,000 lbs.

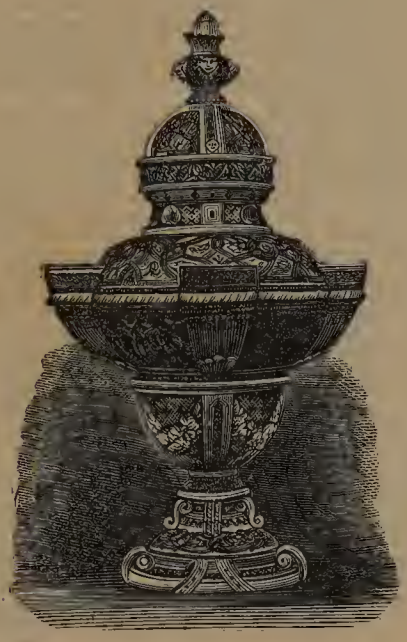
Henri-Deux Ware. (*Ceramics.*) Otherwise known as *faïence d'Oïron.* Fig. 1355.

The ware was made at Oïron, in the southwest of France, in the time of Henry II., of France, and is now very rare, but 37 pieces being known in France, according to M. Brongniart. The emblems of Diane de Poitiers appear on the "Biberou," which was sold in March, 1865, to Mr. Malcolm, for £1,100. It is a little over 10″ in height. The ware is very hard; quite white, and the ornamentation is inlaid, filling incisions or depressions in the body, though flush with the surface. The filliug is generally ochery brown or yellow on the white background, though black, blue, pink, and green colors are known.

Hen'ri-et-ta Cloth. (*Fabric.*) A silk and wool French dress goods.

Her'a-kline. A blasting powder, invented by Dickerhoff, and used in the coal mines of France and Austria. It is composed of picric acid, saltpeter, nitrate of soda, sulphur, and sawdust. The gases produced by its combustion are said not to be injurious, and it burns comparatively slowly, so

Fig. 1355.



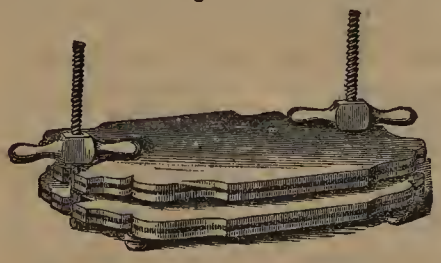
Henri-Deux Ware (Faïence d' Oïron).

that it tears apart the masses blasted, without hurling them violently about.

"*Scientific American*" . . . . . xxxiv. 329.
"*Scientific American Supplement*" . . 134.

Her-ba'ri-um Press. A portable press consisting of a pair of boards with rising screws and

Fig. 1356.



Yale Botanical Press.

hand-nuts. The parts are all detachable so as to pack conveniently in one's valise.

Her'ni-a In'stru-ments. (*Surgical.*) For operating upon rupture; the protrusion of some part from its natural cavity, usually the abdomen. The instruments are numerous for reduction or operation.

For the former see TRUSS, Figs. 6700–6703, pp. 2636, 2637, "*Mech. Dict.*"; and page 9, Part IV., *Tiemann's* "*Armamentarium Chirurgicum.*"

Instruments for operation are needles, knives, directors, syringes, etc. See p. 126, Part III., *Ibid.*; Fig. 134, p. 44, Part I., *Ibid.*; Fig. 144, p. 48, Part I., *Ibid.*

Dr. White's instrument for the radical cure of hernia projects a pair of ligature needles.

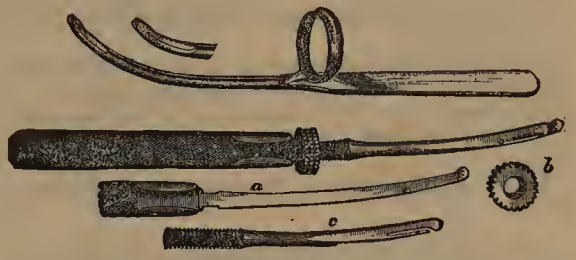
Dr. Warren's hernial ring injector is a graduated barrel with piston and with a needle which is a flat oval in section and twisted throughout its length. The needle is pierced with 10 openings on its side.

De Garmo's hernial syringe has a screw piston and a dome trocar needle.

Her'ni-a-tome'. (*Surgical.*) A knife for operating in cases of rupture of the bowels.

Dr. Allis's herniatome is a probe-pointed instrument with concealed blade, which is uncovered by turning the nut, after the constricting band has been reached. The Fig. 1357 represents the instrument when taken apart: *a*, the blunt-pointed blade; *b*, the nut that controls the movements of the shield: *c*, the shield that may be made to conceal or expose the blade by turning the nut *b*.

Fig. 1357.



Herniatome.

Dr. Warren's concealed bistoury for dividing the hernial ring has a saw concealed by a sheath and projected when the ring has been reached. The instrument serves as its own director.

He-veen'oid. Caoutchouc or its analogue compounded with camphor and sulphur, and vulcanized. Addition of lime or glycerine is sometimes made. — *Gerner.*

The proportions of the constituents to make a soft and hard hevcenoid may be approximately given as follows: —

	Soft Heveenoid.	Hard Heveenoid.
Rubber	2 parts.	3 parts.
Camphor	2 parts.	2 parts.
Lime	1-16 part.	
Glycerine . .		½ part.
Sulphur . . .	½ part.	8 parts.

Para caoutchoue is best for hard hevcenoid, while Nicaragua rubber answers very well for soft heveenoid, and, in fact, is somewhat better adapted.

Hib'bard Spring. (*Railway.*) A spiral nest spring made of flat bars coiled one within another concentrically, to the number of four, wound in right and left directions, alternately.

High Grind'ing. A process of gradual reduction of the wheat by a succession of partial crushings, alternating with sifting and sorting the product. See HIGH MILLING; CYLINDER MILL.

High Loom. (Fr.) *Haute lisse.* A tall tapestry loom of considerable size.

At the top and bottom of the framework composing the loom are horizontal cylinders. Around the upper one, the threads composing the warp are rolled, and around the lower one the tapestry, as it is completed yard by yard, is wound. Between these two cylinders is stretched the warp, upon the threads of which the artist marks in white chalk the outlines of the picture. To these he adds, for the purpose of fixing the light and shades, tracings from the pattern. Then, with this latter conveniently placed for reference, he stations himself against the back of his tapestry, and, with his many-colored worsteds and silks, commences the weaving of the picture. The vertical threads of the warp are divided by a heddle or cross stitch, which keeps half of them in advance of the rest; but those behind can be brought forward by means of small cords or *lisses*, one of which is attached to each warp thread. Between the two sets of threads the workman introduces his left hand and takes up as many of them as is necessary. Through these he passes his curiously-shaped wooden needle from left to right, and with its point piles the stretched thread, which in turn is passed back in the contrary direction through the space opened by shifting the front and back threads. The manipulation of the threads, the combination and proper use of the many colors and shades of worsted and silk, and the working out of the design, require a skill and delicacy only attained by long practice.

High Mil'ling. (*Milling.*) The wheat is reduced by a succession of crackings or of slight and partial crushings, alternating with sifting and sorting the product.

In *low milling* the reduction is effected in a single

crushing, — the usual manner. The velocity is relatively high.

In high milling the velocity is low; the grinding surfaces at first remote, and made gradually to approximate, in successive grindings, as the products become smaller.

In high milling the reduction of the wheat is step by step, and the separation of the products is not alone according to the magnitude of the particles but also by specific gravity. See MIDDLINGS PURIFIER.

Kick, *Mehlfabrikation*, Leipsic, thus describes it: —

"If one rubs grains of wheat gently between mill-stones, which at first are 1-12″ apart, then one quarter less, and then one half less, and so on, there is obtained successively a finer and finer product. By the first operation, which we will call *clipping*, or *pointing*, a part of the shell or outside coat, the brush, and more or less of the germ, will be removed, and there will be produced grains, from which already many little particles which should not appear in the flour have been separated. The outer bran and hulled kernels coming together from between the stones may be separated from each other by passing them through a cylindrical sieve. The hulled grains, by passing them next through the stones brought nearer together, yield a cracked wheat, a product consisting of various finer particles, which may be graded by sifting. The products obtained are called *groats* (bruised or cracked fragments with bran attached), *grits* (smaller fragments), and finer particles, flour. The flour obtained consists for the most part of cells and particles from the outer portion of the grain, fragments of the bran, and of the gluten-coat, which make the flour dark. It is called *pollen*." — *Kick.*

"The *grits* will consist also of a mixture of fragments of outer and inner parts, and bits of bran of the same size, which go through the sieve with the grits. A product corresponding with this somewhat, used to be called *connell*, and is now known as *middlings*.

"The *groats* freed from the finer particles will be again ground, and this produces a second *groats*, *grits*, and flour; the second groats yield also groats, grits, and flour. Particles which are smaller than groats and larger than grits are called 'solutions;' such as are between flour and grits are called *dust;* and these must obviously be produced by cracking. By each succeeding cracking, the flour and grits produced will consist more of particles from the interior of the kernel of wheat, and as the interior cells, that is, the starch-cells, yield a whiter product, so the flour and grits will become more and more fair and white; and this, until the groats after the fourth grinding will possess the form of disks, having only a thin layer of starch-cells. In flour this phenomenon is very striking. The flour from the third groats is much fairer than that from the second or from the first groats; this is less striking in the grits, in that it is still largely mingled with particles of bran. The bran-particles are much lighter than the grits, and this property is taken advantage of to purify the grits by means of a current of air directed upon a thin sheet of falling grits. This work is accomplished by the grits-purifying machine, in which the air operates either by blast or suction.

"In the gradual grinding and purification of the grits lies the essence of the high or grits milling. This can be effected by various modifications. The wheat may be three, four, or five times cracked or bruised; the grits, which have been separated according to their size, may be more or less purified; and finally the purified grits may be either rapidly or slowly ground to flour.

"When the last traces of bran have been separated from the grits and the still finer dust, one obtains by grinding the pure grits and dust, the fairest, whitest flour, a product which it is impossible to obtain in any other way. Of this product there are several grades." — *Horsford.*

See also *CYLINDER MILL, p. 243, *supra;* ROLLER MILL, *infra.* See also diagram under GRANULATING PROCESS, p. 419, *supra.*

System . . . . . "*Am. Miller*," iv. 81.
Table of processes. Hungary . . "*Am. Miller*," vi. 287.
Mill, *Higginbottom & Hutchinson* . *"*Am. Miller*," viii. 117.
*"*Sc. Am. Sup.*," 2179.

High Wines. Crude alcohol of higher proof than *singlings.*

Hill'side Plow. A plow with reversible mold-board and share for turning all the furrows downhill in plowing hill-sides. Also known as a *turning mold-board* plow, and in Britain as a *turn-wrest* plow. See illustrations and remarks, p. 2173, "*Mech. Dict.*"

There are 5 systems: —

1. Two complete sets of mold-boards and shares, right and left-hand respectively, and revolvable on the beam to bring either to working position. The Brabant system, known as *brabant double*, see Figs. 854, 856, pp. 268, 269, *supra*, and Figs. 25-28, vol. v., pp. 31-33, Knight's Report, "*Paris Exposition* (1878) *Reports.*"

2. The old Scotch form: also known as the French *tourne-oreille*, or *charrue Wasse*. The sole and share are permanent; the mold-board is both right and left, either being brought into action as may be desired by means of a lever, the other one shifting into the line of draft on the land-side. The same colter serves for either. The share, mold-board, and land-side are made in one piece (or to move as one), and this is journaled on a horizontal axis at the lower edge. This is unlocked and partially rotated at the end of a furrow, converting what was the land-side into a share and sole, and presenting the mold-board in the other direction. See Fig. 22, p. 29, vol. v., *Ibid.*, and Fig. 6814, p. 2663, "*Mech. Dict.*"

3. A form used also in France, in which two mold-boards, which are united on a horizontal axis on the median line, are unlocked, and then turned half-around, which brings the one now uppermost to the underneath position, both the mold-boards being then presented to the right hand as they are now to the left. Fig. 23, p. 30, vol. v., "*Paris Exposition* (1878) *Reports.*"

4. A form which has a right-handed and a left-handed body placed back to back; that is to say, one presented forward and the other rearward. The beam and handles turn on a vertical pivot in the center of the body, and either the right or left-handed portion can be used by turning the beam and handles and presenting them in the appropriate direction. The rear portion of each mold-board is hinged, which allows the one in use to lap over the other, which lies back; this avoids the necessity for making the body the sum of the lengths of the two bodies.

An old English turn-wrest plow, known in its day as Hays's, was constructed on the same principle, but without the hinged wings to the mold-boards. See Fig. 24, p. 30, vol. v., "*Paris Exposition Reports.*"

5. A system in which two sets of mold-board and share are used, right and left-hand respectively; the one in use lowered into the furrow while the other is elevated clear of the soil without deranging its position other than the clear vertical movement. A British form shown in Fig. 2509, p. 1103, "*Mech. Dict.*"

Hind Sight. The rear sight of a gun; *open, California, peep, vernier,* etc., which see. See also HAUSSE, and list under SIGHT.

Hinge. See under the following heads: —

Awning hinge.	Loose-pin hinge.
Ball-joint hinge.	Plate hinge.
Butt.	Port hinge.
Butt hinge.	Screw hook-and-eye hinge.
Coach hinge.	Screw hook-and-strap hinge
Crate hinge and hasp.	Spring hinge.
Hasp.	Strap hinge.
Hook-and-eye hinge.	T-hinge.

Hinge Burn'er. A burner the chimney ring of which is hinged to the lamp-top.

Hip'-joint Splints. (*Surgical.*) See MORBUS COXARIUS SPLINT.

Hitch. A fastening made by passing a light line around a rope, or a rope around a mast or post, so that the line, or rope, crosses its own body and binds.

For list of hitches see KNOT.

Hob. A hardened steel mandrel with a threaded portion which is fluted. Used in cutting screw tools and chasers. See HUB, *Fig. 2600, p. 1139, "*Mech. Dict.*"

Hodge Brake. (*Railway.*) A lever car-brake, invented by N. Hodge, for operating upon all the wheels of a car simultaneously from a single wheel. Fig. 642, p. 426, *Forney's "Car-builders' Dictionary."*

Hoe'ing Ma-chine'. (*Agric.*) See HORSE HOE.

Hog Ring'er. A special instrument for placing anti-rooters in the snouts of hogs. The *ring* is usually a wire or plate, with prongs which are thrust through the cartilage of the nose, and bent over to prevent retraction. The ringer is a pincers which holds the *ring* and thrusts it into place.

Hogs'head Ma-chin'e-ry. See list under BARREL MACHINERY.

Hoist'ing, Shaft'ing, Gear'ing, Grap'pling, etc. See under the following heads: —

Abutment crane.
Accumulator.
Anchor fish-hook.
Angle block.
Angular belting.
Anti-friction block.
Anti-friction press.
Anti-friction roller.
Awning block.
Ball-and-socket coupling.
Balance crane.
Baromotor.
Barrel clamp.
Barrel skid.
Becket block.
Belt.
Belt clamp.
Belt coupling.
Belt fastener.
Belting.
Belt-lacing.
Belt-shipper.
Belt-tightener.
Belts, tool for putting on.
Bevel gearing.
Boom-sheet block.
Brake purchase.
Builder's hoist.
Bullet.
Bull's-eye.
Buntline leader.
Bushing.
Capstan.
Cargo-block.
Cellar crane.
Cellar lift.
Chain.
Chain belt.
Chain guide.
Chain hoist.
Chain pulley.
Chain-pulley block.
Changeable speed gear.
Clew.
Clip pulley.
Clothes-line block.
Clutch.
Clutch coupling.
Clutch pulley.
Coal elevator.
Coal hoist.
Coal-hoisting tub.
Coal-whipping machine.
Cog-wheel.
Compression coupliug.
Cone gear.
Cone pulley.
Conical bearing.
Connecting rod.
Conveyor.
Core wheel.
Counter-gear.
Countershaft.
Countershaft clutch.
Crab.
Crane.
Crane engine.
Crane jib.
Cross-head.
Davit block.
Dead eye.
Deck block.
Deck-hoisting engine.
Derrick.
Derrick winch.
Detaching hook.
Differential block.
Differential movement.
Differential pulley.
Differential pulley-block.
Dock block.
Dog power.
Door hanger.
Door roller.
Dovetail clutch coupling.
Draft pole.
Drive chain.
Driving pulley.
Dumb waiter.
Dumb-waiter pulley.
Dumping bucket.
Eccentric.
Eccentric clamp.
Edge-laid belt.
End play.
Elevator.
Elevator boot.
Elevator bucket.
Elevator chain.
Elevator engine.
Elevator pulley.
Endless chain horse-power.
Expanding pulley.
Eye.
Eye-block.
Fast-and-loose pulleys.
Fire escape.
Flange pulley.
Flexible coupling.
Flexible mandrel.
Flexible shaft.
Floor hanger.
Foot power.
Foundry crane.
Frictional gear.
Friction clutch.
Friction clutch pulley.
Friction drum.
Friction gear.
Friction pulley.
Friction wheel.
Gantry crane.
Gear.
Gearing.
Gimmal rings.
Gin block.
Gin power.
Gin pulley.
Gin wheel.
Grain elevator.
Grapple hook.
Gun lift.
Gut belting.
Hand hoist.
Hand winch.
Hanger.
Haul-up gear.
Hay-fork pulley.
Heart.
Hod elevator.
Hoist.
Hoisting and conveying apparatus.
Hoisting apparatus.
Hoisting block.
Hoisting drum.
Hoisting engine.
Hoisting machine.
Hoisting screw.
Hook-and-swivel block.
Horizontal jack.
Horse-bar.
Horse-hay-fork block.
Horse-power.
Horse-power jack.
Horse-power speed-regulator.
Hydraulic capstan.
Hydraulic crane.
Hydraulic elevator.
Hydraulic hoist.
Hydraulic jack.
Hydraulic lift.
Hydraulic valve.
Ice elevator.
Ice elevator chain.
Ice screw.
Inclined plane.
Inclined plane winding apparatus.
Intermediate motion.
Iron-strapped block.
Jack.
Jack press.
Jack screw.
Jetty crane.
Jib crane.
Jib-sheet block.
Journal.
Journal bearing.
Journal box.
Journal brass.
Key.
Knocking.
Ladder.
Lathe hoist.
Lever jack.
Lifter.
Lifting jack.
Lifting tackle.
Liquid bearing.
Lizard.
Locomotive steam-crane.
Loose-hook block.
Loose pulley.
Lost motion.
Man-rope eye.
Mast hoop.
Match-hook block.
Monkey wheel.
Motion.
Mounted power.
Open-sheave block.
Overhead crane.
Overhead traveling crane.
Overhead work.
Overhung head.
Overwinder.
Overwinding check.
Parrel truck.
Parting pulley.
Peak halyard-block.
Pedestal hanger.
Pedomotor.
Pillow block.
Pipe turnbuckle.
Pit-head gear.
Platform crane.
Pony gear.
Portable crane.
Portable hand-crane.
Portable hoist.
Portable steam crane.
Post box.
Post windlass.
Power hoisting-block.
Pulley.
Pulley block.
Pulley lubricator.
Pulling jack.
Quarter-turn belt.
Quarter-twist belt.
Rack-and-pinion jack.
Radius bar.
Ratchet coupling.
Ratchet motion.
Rawhide.
Reversible winding engine.
Right-and-left coupling.
Ring bush.
Roller grip.
Roofing block.
Rope eye.
Rope driving gear.
Rope gearing.
Rope-strapped block.
Rubbish pulley.
Safety apparatus.
Safety catch.
Safety hatch.
Safety hoist.
Safety winch.
Scandinavian belting.
Screw hoist.
Screw machine.
Self-dumping coal-tub.
Self-oiling bearing.
Shaft coupling.
Shaft hanger.
Shafting.
Shafting cup.
Sheave.
Sheave bushing.
Ship jack.
Ship's hoist.
Single-rail crane.
Sister-hook block.
Skew-bevel wheel.
Snatch-block.
Socket gudgeon.
Spiral conveyor.
Split wheel.
Speed regulator for horse-powers.
Steam capstan.
Steam crane.
Steam winch.
Stone lifter.
Strap shifter.
Stiff-hook block.
Swing block.
Swivel block.
Swivel-hook block.
Tackle.
Tackle block.
Telescopic elevator.
Tension roller.
Thimble.
Thimble-eye block.
Tightening pulley.
Tom.
Top-mast truck.
Traction gearing.
Transfer elevator.
Traveler rope.
Traveling crane.
Traversing jack.
Tread power.
Tripod jack.
Truck.
Underground hauling engine.
Underground winding engine.
Unloading apparatus.
Universal joint.
Variable speed attachment.
Wagon crane.
Wagon jack.
Wall crane.
Warehouse hoist.
Water bearing.
Well-wheel block.
Well windlass.
Wharf crane.
Whelps.
Whip crane.
Whip gin.
Winch.
Winding engine.
Windlass.
Wire belt.
Wire rope.
Wire-rope splice.
Wire-rope thimble.
Wire-rope transmission.
Worm gearing.
Woven-wire belting.
Wrapping connector.
Wrecking crane.
Z-crank.

See references: —

Hoisting and sea-water distillery app. combined, Br. . * "*Engineer*," xlix. 334, 335.
Apparatus . . . . . * "*Scientific American Sup.*," 192.
And conveying bucket . * "*Eng. & Min. Jour.*," xxi. 271. Fig. 494, p. 150, *supra*. Fig. 7006, p. 2798, "*Mech. Dict.*"
Clamp, Fr. . . . . * "*Scientific Amer.*," xxxvii. 179.
Machinery . . . . . Figs. 3, 4, 6, 7, 8, "*Engineer*," xlix. 334.
Machine, portable . . * "*Scientific Amer.*," xxxvii. 406.
Engine, *Bacon* . . . . * "*Man. & Builder*," ix. 175.
Engine, double cylinder * "*Man. & Builder*," xi. 103.
Self-landing and delivering, *Barker*, Br. . . * "*Engineering*," xxi. 389.
Hoist engine, mining. *Berry & Place* . . . * "*Min. & Sc. Press*," xxxiv. 225.
Machine brake, *Cherry*, Br. . . . . * "*Engineer*," lxv. 180.

Hoist, *Clem & Morse* . * "*Iron Age*," xxv., May 6, p. 3.
Copeland & Bacon . * "*Man. & Builder*," ix. 247.
Engine, *Davis* . . . . * "*Iron Age*," xxi., Jan. 31, p. 7.
Machine, *Johnson* . . . * "*Scientific American*," xxxviii. 102.
Engine, *Lidgerwood* . * "*Man. & Builder*," xi. 154.
Engine . . . . . * "*Man. & Builder*," xi. 169.
Engine, rotary.
Lidgerwood Man. Co. * "*Man. & Builder*," viii. 265.
Engine, *Mundy* . . . * "*R. R. Gazette*," xxii. 64.
Engine . . . . . * "*Man. & Builder*," ix. 129.
Machine, friction . . . * "*Man. & Builder*," viii. 78.
Machine, portable . . * "*Scientific Amer.*," xxxvi. 338.
Engine for mines, *Niles* * "*Min. & Sc. Press*," xxxviii. 105, 145.
Engine. *Parke & Lacy* . * "*Min. & Sc. Press*," xxxvii. 401.
Horse-power for.
Reynolds . . . . . * "*Min. & Sc. Press*," xxxvi. 257.
And crane, self-sustaining, *Thomas*, Br. . . * "*Engineer*," xlix. 386.
Engine, portable.
Williamson . . . . * "*Scientific American Sup.*," 545.
* "*Engineering*," xxii. 7.
* "*Engineering*," xxii. 117.
Engine "Yellow Jacket" * "*Scientific American*," xli. 117.

Hoist'ing and Con-vey'ing Ap'pa-ra'tus. A system for lifting and transporting buckets used in mining, grading, loading, and discharging vessels, transporting ores, minerals, etc., from positions difficult of access.

Two forms are shown: one under WIRE WAY, Fig. 7006, p. 2798, "*Mech. Dict.*"; the other under CABLE CARRIER, Fig. 494, p. 150, *supra*.

Hoist'ing Drum. A pulley on which the hoisting-rope winds. In Fig. 1358 it is shown in

Fig. 1358.

Friction Hoisting Drum.

connection with a friction clutch which conveys the motion of the shaft to the drum. The cone slips on a feather on the shaft and so locks the parts together as to revolve the drum.

Frisbie's device is also shown in section in Fig. 1097, p. 357, *supra*.

Hoist'ing En'gine. Fig. 1359 shows Frisbie's hoisting machine, operating by means of the friction-clutch in Fig. 1358. As shown, it is especially intended for pile-driving. The rope is not detached from the hammer, but unwinds from the drum, which runs free on the shaft when the friction is removed and the hammer descends to do its work.

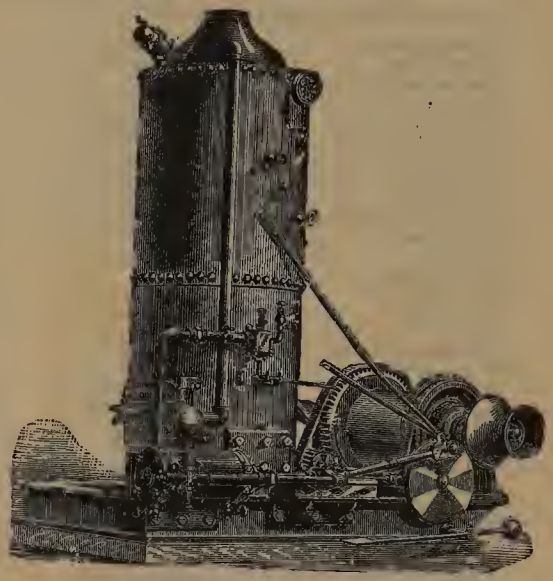
In the Lidgerwood hoisting machine, the engine is rotary and connected directly to the drum-shaft by spur-wheel and pinion. For platform elevators the machine has double or compound gearing, a brake which rests on the fly-wheel when the machine is stopped, and is lifted when the machine is started. The drum is large and has grooves for the wire cable.

In the Carr hoisting engine the engine runs constantly in the same direction, and the connection with the drum is by internal friction gearing.

See also FRICTION DRUM HOIST, Fig. 1009, p. 357; CELLAR LIFT, Fig. 573, p. 180; and ELEVATOR ENGINE, Fig. 958, p. 310, *supra*.

See also HYDRAULIC ELEVATOR; HYDRAULIC LIFT, "*Mech. Dict.*," *et infra*.

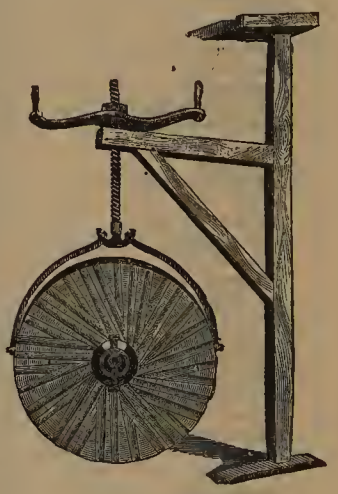
Fig. 1359.



Hoisting Engine.

Hoist'ing Screw. (*Milling.*) An elevating arrangement for lifting the runner from off the bed stone when it becomes necessary to dress either of them. The bail engages studs on the side of the stone which is then revolvable on the studs as centers in order to invert it and expose the working surface upwardly.

Fig. 1360.



Hoisting Screw.

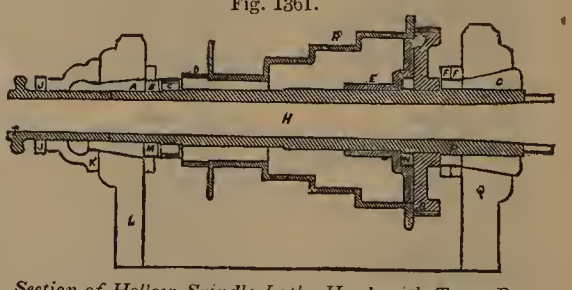
Hole Gage. A tapered metallic slip graduated to show the diameters of holes into which it may be thrust. See BARREL GAGE, Fig. 216, p. 77, *supra*.

Hol'low Plun'ger Pump. A pump made for mining and quarrying purposes, to remove water from the workings. Plunger pumps are shown in Fig. 3845, p. 1752, "*Mech. Dict.*" The tubular plunger is considered to have an advantage in muddy water.

Hol'low Spin'dle Lathe. A lathe with a head stock, the spindle of which is hollow.

P is the spindle; *H*, the hole 1⅝" diameter; *L* and *Q*, the standards of the head stock which have tapering holes to

Fig. 1361.



Section of Hollow Spindle Lathe Head with Taper Boxes.

receive the round boxes, *A* and *G*. These are turned to fit and then cut in half, being secured by the nuts, *F F* and *B*, *K*. *O* is the large spindle gear which is kept in place by the nut, *N*. *R* is a four-section cone pulley; *E*, the cone head; and *D*, the small gear on the cone. *C* is the feed-gear on the spindle. The end thrust is taken by a step held by the bracket *K* and check-nut *J*.

* "*Iron Age*," xxii., Nov. 28, p. 1.
* Fig. 2538, p. 1113, "*Mech. Dict.*"

Hol'low Spoke Wheel. (*Railway.*) A car wheel with spokes cored in casting, Figs. 166, 167, *Forney's "Car-builders' Dict."*

Hol'o-phote. (*Whole Light.*) A lamp which by refraction or reflection collects wandering rays, so that the whole of the beams are directed in the requisite course for the purpose required.

See CATOPTRIC LIGHT; DIOPTRIC LIGHT, "*Mech. Dict.*," *et supra*. Also p. 1113, "*Mech. Dict.*"

The *holophote* of Mr. Preece is a lamp for illuminating the depths of the sea. Its purpose is to detect advance of an enemy's torpedo, "*Scientific American*," xl. 358.

Ho-mo-ge'ne-ous Steel. Steel without blows (*acier sans soufflures*), *M. Euverte, Terre Noire, Fr.*

Hone. The Cinghalese hone is made of *capitia* resin combined with corundum in a state of impalpable powder, the resin rendered liquid by heat, and the corundum well incorporated. The mixture is poured into a wooden mold, and its surface leveled and smoothed while it is hot.

Oil-stone making, *Beach* . . . * "*Sc. Am. Sup.*," 293.

Hon'ey Ex-tract'or. A rotating cage in which comb honey is placed and the honey extracted by centrifugal action, the cage moving at high speed. A form of centrifugal machine. See also HYDRO-EXTRACTOR.

In Emmons's honey extractor an up and down motion is given to the comb to assist in breaking the cells.

"*Scientific American Sup.*" . . . . . * 731.
"*Scientific American*" . . . . . * xl. 179.

Hon'ey Knife. One with a thin blade bent at an angle to the handle.

Hood. (*Manége.*) That part of a horse blanket which covers the horse's head and neck.

Hoof Boot. (*Manége.*) A leathern boot made to fit the hoof of a horse, with an iron shoe attached; used as a protection to the hoof in case a shoe is lost, or where the hoof is in a condition that will not permit the nails being driven in it.

Hoof Cush'ion. 1. A pad in the hollow of the hoof to keep the sole moist: curative or preventive of dry cracking.

2. A roll attached to the fetlock and encircling the corona of the foot to prevent interfering.

Hoof Pick. (*Manége.*) A claw to remove stones jammed between the sole and the shoe; or the frog and the shoe.

Hook. A curved prehensile instrument. See list, pp. 1114, 1115, "*Mech. Dict.*"

1. (*Surgical.*) A frequent form in instruments, *e. g.* Hooked gorget used in supra-pubic lithotomy. Tonsil hooks, single and double; blunt hook for fistula or for parturition; tenaculi, etc.

2. (*Nautical.*) Among these are: —

Bench hook.
Block hook.
Boat hook.
Clip hook.
Gaff-top-sail hook.
Match hook.
Self-mousing hook.
Sister hook.
Tackle hook,
etc.

3. (*Fishing and Whaling.*)

a. Blubber hook.
Clam hook.
Drail.
Fly hook.
Gaff.
Grapple hook.
Junk hook.
Lance hook.
Lever hook.
Line hook.
Lip hook.
Lock hook.
Pew gaff.
Spinner.
Spring hook.
Squid jig.
Tackle.
Trawling hook, etc.

See FISH-HOOK, *supra*.

b. The backward curved portion of a wing net which constitutes it a space nearly inclosed. See STAKE NET.

4. A means for suspension. BARREL HOOK, Fig. 221, p. 78; BALE HOOK, Fig. 181, p. 68, *supra*.

A small hook for suspending calendars and what-not. *Heyl's* suspension hook; an ornamental plate with adhesive back surface and a wire loop-hook.

5. A means of handling: *e. g.*, BALE HOOK, Fig. 182, p. 68, *supra*.

The word *hook* appears in various and numerous compounds: —

Hook and eye screw-bolt.
Hook and eye hinge.
Hook and eye turn-buckle.
Hook and swivel block.

Hook and Lad'der Truck. A carriage for conveying ladders and hooks for engaging in extinguishing fires. The former useful in rescuing persons and in giving firemen entry into and points of advantage in fighting fire in buildings. The latter for pulling down dangerous walls, or buildings, which add to the extent of the conflagration.

The carriage being long, the forward truck turns under the carriage, and the hind truck is also swiveled, and is guided by a steering wheel.

Hook Nee'dle. (*Hydraulic Engineering.*) A hook-ended needle used in sewing mats for lining river banks or making levees. It is used in making the lock-stitch and also in the hook needle fastening.

The method of working is as follows: The wires are laid upon the ground, straight or crossways, as the case may be, and the material for the mat laid over them. The needle is passed through the mat, and engaging the wire pulls a loop

Fig. 1362.

Hook Needle Fastening.

up through the mat; through this loop a bobbin is passed in the lock-stitch or the butt-end of a brush in the hook needle fastening. A man at the end of the wire pulls all down very solid, and a third man stands on the wire where it crosses the brush or toggle to prevent back-slip, and presses the brush down while the next stitch is being made.

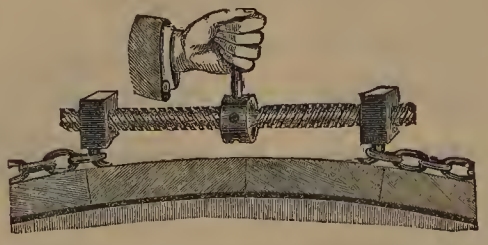
Hook Net. (*Fishing.*) One with an L-shaped continuation forming a sort of pocket. See STAKE NET. Also known as a *trap*-net.

Hook Plate. A supporter for RADIATORS, which see. See also COIL PLATE, Fig. 656, p. 208, *supra*.

Hoop. A band of metal or of wood around a cask, bale, or box.

Zollers' provisory hoop, Fig. 1363, for setting up large vats, has a right and left coupling screw, to heads on which are hooks engaging the ends of the straining chain.

Fig. 1363.



Provisory Hook.

Fig. 1364 is a French hoop for cider and wine-presses. It is made in three sections, and may be taken off when the pomace is well pressed in order to remove the exhausted material more readily.

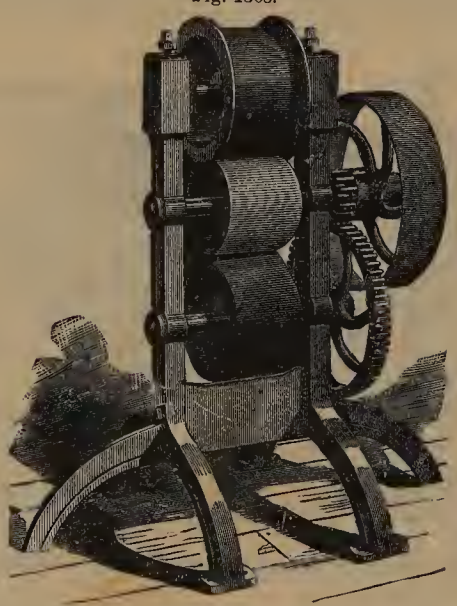
Fig. 1364.

Hoop for Cider-press Vats.

Hoop-bend'ing Ma-chine'. A machine for giving flexibility to the rived sapling, for forming a hoop.

The machine has an iron frame in which are three turned

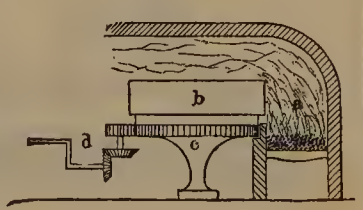
Fig. 1365.



Machine for Bending Wooden Hoops.

iron pulleys. A belt is so placed upon the pulleys as to drive them all when one is put in motion. The hoop is entered between the belt and the middle pulley, which is carried around the pulley and held close to it by the belt, which prevents its breaking.

Fig. 1366.



Furnace for Heating Cannon Rings.

a. Furnace.
b. Hoop.
c. Revolving Table.
d. Crank and Gear.

Hoop-heat'ing Fur'nace. One for expanding a steel ring which is to be slipped on to a cannon on the building-up, or reinforce principle. When the hoop has a blue heat it is removed and slipped into place on the gun, which has been turned to a size to receive it. See ARMSTRONG GUN, "*Mech. Dict.*"

Hoop-ma'king Ma-chine'. A machine for riving hoops from the pole and finishing them.

It consists of a *splitter* and *finisher*.

A large splitter is used for heavy, that is to say, for three, four, six, or eight-part poles (which will yield that number of hoops), and a smaller splitter for smaller poles. The splitters cut through the center of the poles, and in a single rapid thrust divide at one operation each pole into all the splints which it contains.

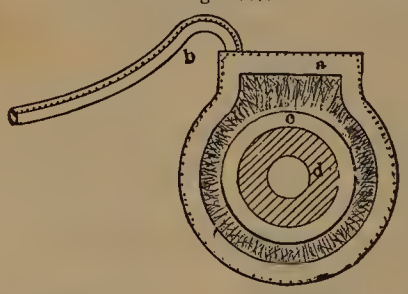
The finisher, in one rapid operation, cuts off the knots, takes out the core, finishes the face of the hoop, crimps it, and delivers it a perfect hoop, exactly even in thickness from end to end.

The splitter will split 12 to 15 poles per minute. The smaller finisher will run through 12 hoops of 6′ length per minute. The larger finisher will run through 10 hoops of 7½′ length per minute. — *Hart.*

Hoop-punch'ing Ma-chine'. A machine having rollers for flaring, and punches for punching and riveting respectively, the hoop-iron for making cask hoops.

Hoop-shrink'ing Ap'pa-ra'tus. An apparatus for shrinking a steel hoop which has been

Fig. 1367.



Apparatus for Cooling Hoops.

a. Watering Pot.
b. Hose Pipe.
c. Hoop.
d. Body of Gun.

heated to "blue" and slipped on to the core of a cannon, in the building-up or reïnforce method. It is a sort of circular watering-pot which bathes all portions of the exterior of the hoop equally.

The system of reïnforce rings is shown in the 100-ton gun, Fig. 526, p. 160, *supra*.

Hop'per. A funnel-shaped tank, spout, or vessel, either bottomless or with a movable door or flap beneath.

A coal hopper, grain hopper, etc., for discharging into cars or otherwise.

A soil hopper in a water-closet.

A car hopper, or bottom discharge of a coal car.

A weighing hopper; the cistern holding the grain and discharging below. See GRAIN SCALE.

Hop'per Barge. A barge used in dredging operations, to receive the silt from the dredger, convey it away, and drop it at any suitable place for deposit.

Hawks, Crawshay, & Co. * "*Engineering*," xxix. 354.
Dredger "Willunga," Australia . . . . . * "*Engineer*," xlvii. 60.
Dredge, twin screw, Newhaven, Br. . . . . * "*Engineer*," xlviii. 84, 88.

Hop'per Clos'et. A water-closet for public uses, in which the pan stands upon an S-trap and periodical flushing is depended upon for cleanliness.

Hop'per Cock. A faucet belonging to the hopper of a water-closet, so arranged as to give a wash when the seat is relieved of weight. See Fig. 1368.

Hop'per Scales. Elevator scales. See GRAIN SCALE.

Hop Pick'er. A device resembling a clothes-wringer and propelled by a treadle.

Fig. 1368.

Hopper Cock.

It consists of two rubber rollers, so constructed as to draw in the branch, while two steel rollers, having an opposite action, pick the hops from it. From the picker the hops run into a sack, which, when filled, is taken to the separator, which sorts the hops from all leaves or stems which may have gone into the sack, and thence to the hop house.

Cultivator, *Howard*, Eng. * "*Scientific Amer.*," xxxvii. 163.
Knight, Br. . . . . * "*Engineering*," xxiv. 98.

Hor'i-zon'tal Bor'ing Ma-chine'. 1. A machine with a horizontal table on which work is chucked for boring.

See HORIZONTAL LATHE, Fig. 2562, p. 1121, "*Mech. Dict.*," and Fig. 389, p. 122, *supra*.

2. A machine with horizontal boring-tool stock.

See HORIZONTAL DRILL, Fig. 2560, p. 1120, "*Mech. Dict*"; BORING MACHINES, 811, 817, 818, 820, pp. 340, 341, *Ibid.*: UNIVERSAL BORING MACHINE, Fig. 392, p. 123, *supra*; ANGLE CARBORING MACHINE, Fig. 75, p. 35, *supra*.

Hor'i-zon'tal Check Valve. One arranged in a horizontal pipe, as in Fig. 609, p. 192, *supra*.

Hor'i-zon'tal En'gine. One, the piston of which works horizontally.

The following references may be consulted: —

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* "*Sc. American*," xxxviii. 310.
* "*Am. Miller*," v. 126.
Corliss, 1000 h. p., Br. . * "*Engineering*," xxi. 412.
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* "*Engineer*," xliii. 293.
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Exeter Machine Works . * "*Scientific American*," xli. 51.
Fenby, Br. . . . . * "*Engineering*," xxvi. 189.
Gadd . . . . . * "*Engineer*," xlii. 77.
Gen. Eng. & Boiler Co. Br. . . . . * "*Engineer*," xliv. 88.
* "*Engineering*," xxiii. 341.
Gibbons, Br. . . . . * "*Engineering*," xxv. 123.
Hampson, Whitehill & Co. * "*Scientific American Sup.*," 404.
Harris-Corliss . . . . * "*Am. Miller*," v. 112.
Hindley, Br. . . . . * "*Engineer*," xlix. 394.
Marshall, Br. . . . . * "*Engineering*," xxvi. 31.
Norwalk Iron Works . * Thurston's "*Vienna Exp. Rep.*," ii. 25.
Pickering & Davis . . * Thurston, "*Vienna Rep.*," ii. 35.
Porter-Allen . . . . . * "*Manuf. & Builder*," x. 217.
* "*Iron Age*," xxii., Oct. 10, p. 1.
Reading Iron Co., Br. . * "*Engineer*," l. 39.
Robey, Br. . . . . * "*Engineering*," xxvi. 466.
Snyder, "Little Giant" * "*Sc. American*," xxxix. 63.
Sulzer Bros., Switz. . . * Thurston's "*Vienna Exp. Rep.*," ii. 21.
Tangye, Br. . . . . * "*Scientific American Sup.*," 3943.
* "*Engineering*," xxiv. 492.
* Thurston's "*Vienna Exp. Rep.*," ii. 29.
Turner, Br. . . . . * "*Engineering*," xxiv. 457.
"Gippeswyk," Br. . . * "*Engineer*," xlviii. 4.
* "*Engineer*," xliv. 422.
Walschaert, Bel. . . . "*Engineering*," xxvii. 29.
Watts . . . . . * "*Engineer*," xliii. 409.
* "*Scientific American Sup.*," 1316.
Condensing, *Brown* . . * "*Engineering*," xxv. 475.
Cond. exp., *Brown*, Switz. . . . . * "*Engineering*," xxix. 75.
Cond. exp., *Bertram*, Br. * "*Engineer*," xliv. 136.
Cond., *Brinkmann*, Ger. * "*Engineering*," xxx. 170.
Cond. exp., Collmann, Ger. . . . . * "*Engineering*," xxviii. 109.
Cond., *Deakin, Parker & Co.* . . . . . * "*Engineer*," xlvi. 461.
Cond., *Dick & Stevenson*, Br. . . . . * "*Engineering*," xxv. 184.
Cond, *Duvergier*, Fr. . "*Engineering*," xxv. 425, 429.
Cond *Fourlinnie*, Belg. * "*Engineer*," xlv. 350, 364.
Cond. exp., *Lebrun*, Fr. * "*Engineering*," xxx. 246.
Cond., *Soc. Marcinelle*, Belg. . . . . * "*Engineer*," l. 350.
Cond. high-pressure engine, *Marshall*, Br. . * "*Engineer*," xlvi. 446, 451.
Cond., *Marshall*, Br. . * "*Engineering*," xxvi. 453.
Cond. exp., *Nolet*, Belg. * "*Engineer*," xlvii. 226.
Cond., *Robey*, Br. . . * "*Engineer*," xlvii. 452.
Cond., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlvii. 470.
* "*Engineering*," xxviii. 5.
Surface cond., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlv. 289, 292, 307.
Cond., *Soc. Suisse*, Switz. . . . . * "*Engineer*," xlv. 365.
Cond. exp., *Sulzer*, Switz. . . . . * "*Engineer*," xlvi. 150.
Expansion, *Bennie*, Br. * "*Engineer*," xliv. 373.
Exp., *Collmann*, Ger. . * "*Engineer*," xlv. 144.
* "*Engineering*," xxx. 455.
Exp., *Corliss*, Belgian . * "*Engineer*," xlv. 405.
Exp., *Davey, Paxman & Co*, Br. . . . . * "*Engineer*," xlviii. 5.
Exp pumping, *Escher, Wyss & Co.*, Switz. . * "*Engineering*," xxx. 348.
Exp., variable, *Gen. Eng. & Boiler Co.* . . * "*Engineering*," xxi. 357.
Exp., *Halpin*, Br. . . * "*Engineering*," xxvii. 480.
Exp., *Hayward, Tyler & Co.*, Br. . . . . * "*Engineer*," xlviii. 145.
Exp., *Marshall*, Br. . . * "*Engineer*," xlvi. 427.
Variable cut-off, *Porter-Allen* . . . . . * "*Engineering*," xxvii. 107.
Exp., *Reading Iron Co.* Br. . . . . * "*Engineering*," xxx. 41.
Exp., *Reading Iron Works*, Br. . . . . * "*Engineer*," xlviii. 17.
Exp., *Rensing*, Ger. . . * "*Engineering*," xxx. 623.
Exp., *Ruston & Proctor*, Br. . . . . * "*Engineer*," xlviii. 447.
Exp., *Corliss*, Saltaire, Br. . . . . * "*Engineering*," xxx. 111.
Exp. gear, *Shanks*, Br. . * "*Engineer*," xlvi. 13.
* "*Engineering*," xxvii. 561.
Exp., *Socin & Wick*, Switz. . . . . * "*Engineer*," xlvi. 350.
Exp. gear, *Virck*, Ger. . * "*Engineering*," xxviii. 187.
Exp., *Zimmerman*, Ger. * "*Engineering*," xxx. 565.
Non-cond., *Ruston & Proctor*, Br. . . . . * "*Engineering*," xxviii. 465.
Cond. pumping, Newent colliery, Br. . . . . * "*Engineer*," xlix. 27.
Pumping, St. Maur, Fr. * "*Engineering*," xxvi. 170–173.
Reversing high-pressure, *Galloway*, Br. . * "*Engineer*," l. 310.

Hor'i-zon'tal Mor'tis-ing Ma-chine'. One, the auger and bit of which act in a horizontal direction.

Fig. 3339, p. 1483, "*Mech. Dict.*"; CHAIR MORTISER, Fig. 594, p. 189, *supra*.

Hor'i-zon'tal Pump. One, the barrel of which is horizontal.

A convenient form of lever handle-pump, and the usual position in steam pumps: instances (9) on pp. 2357–2359, "*Mech. Dict.*" See list under PUMP, p. 1827, *Ibid.*

Hor'i-zon'tal Saw Mill. One, the saw of which traverses horizontally: not a frequent position, but found in some special saws.

Horn. 1. (*Railway.*) One of the projecting parts of a pedestal, between which the journal-boxes work.

Horn-block in British parlance. See PEDESTAL, Fig. 3595, p. 1647, "*Mech. Dict.*"

Horn-block facing-machine, Lond. & N. W. Ry., * "*Engineering*," xxviii. 261.

2. (*Music.*) A brass wind instrument, with a mouth-piece, made in great variety. The name characterizes a family. Speaking in the most general terms, it may be said that they are of all sizes, and consequently of pitch, as the larger tubes vibrate more slowly. The pitch is also varied by

movable crooks. Some horns have keys, other pistons, cylinders, or slides. They have also a capacity for another variation of sound, known as the *open* or *closed;* the latter produced by closing more or less the *pavilion* or bell by means of the hand.

See CORNET, p. 222, *supra*. Also instances (11), Fig. 2564, p. 1122, "*Mech. Dict.*"

Horn Block. The casting with two dependent branches, between which the axle-boxes of a car work as the springs expand and contract. A *pedestal.*

Horn'er. A tool for breaking off the awns of barley. *Awner.*

Horn Ma-chine'. A machine for sewing soles to shoes.

The shoe being slipped on a *horn*, gives name to the machine. A *horn* is shown in Plate LX., opposite p. 2162, "*Mech. Dict.*"

Horn Press. A power press for closing the side-seams of cans and boxes, which are for the purpose slipped upon a horn protruding from the standard of the machine.

Ho'ro-graph. An instrument for making a multitude of perforations on a line, as guided, through a thin paper to be used as a stencil.

It resembles the Edison electric pen in the result, but the means of driving the *Newton, Wilson & Co.* horograph is a spring and clock-work.

"*Engineer*" . . . . . * xlvii. 313.
"*Scientific American*" . . . . . * xl. 377.

Horse Bar. The lever of a horse-power. A sweep.

Horse Bis'cuit A food for campaigning horses; adopted in Prussia and Russia. Also known as *oat comfit.*

It consists of: —

Oat flour	30
Dextrinated pea meal	30
Rye flour	30
Linseed meal	10
Or:	
Oat flour	40
Dextrinated pea meal	40
Linseed meal	20
Or:	
Pea meal	20
Wheat flour	20
Corn meal	20
Rye flour	20
Grated bread	10
Linseed meal	10

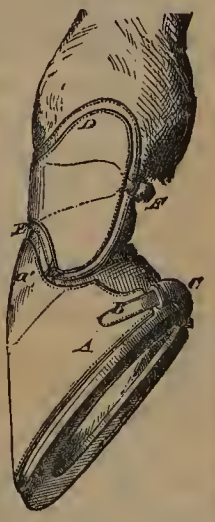
Or analogous mixtures.

3½ lbs. of the oat comfit are estimated to have a value equal to 12 lbs. of oats.

A daily ration is 3½ lbs. comprising, say 26 biscuits, 4 to 5″ in diameter and 4-10″ thick. The biscuits are fed broken, dry or wet; 7 in the morning, 12 at noon, 7 in the evening.

Horse Boot. (*Manége.*) An attachment designed to protect the hoof, pastern joint, and fetlock joint from being cut or injured by the over-reaching or interfering of the horse when being driven at high speed.

Fig. 1369.



Horse Boot.

The lower portion, *A*, covers the hoof, and is secured by strap *B*, which passes around the heel. The portion *a′* covers the corona, and a tube, *C* on *B*, prevents the boot from slipping. *D* is the upper or speedy-cut boot, which is concaved in front to fit the portion *a′* of the hoof-boot, to which it is secured by straps *E E*. The pad *D* is secured by strap *F*.

Horse Car. (*Railway.*) *a.* One fitted to carry horses.

b. A street-car drawn by horses.

Horse-car heating . . . "*Scientific American*," xli. 393.

Horse Fix'tures.

Boot, *Fennel* . . . . . * "*Min. & Sc. Press*," xxxv. 81.
* "*Scientific Amer.*," xxxvi. 386.
Collar, hameless.
Fisher & Watson . . * "*Scientific Amer.*," xlii. 243.
Detacher, *Ehret* . . . * "*Scientific American Sup.*," 460.
Driving by electricity, Fr. "*Iron Age*," xix., April 12, p. 1.
Groomer, *Newton* . . . * "*Scientific Amer.*," xxxiv. 402.
Motions, science of . . * "*Scientific Amer.*," xxxix. 239.
Tail clipper, Br. . . * "*Engineer*," xliv. 424.
Holdback, harness.
Knight & Hilliard . . * "*Scientific Amer.*," xlii. 195.
See "*The Horse in Motion*," *Stillman*, J. R. Osgood & Co., Boston, 1882.

Horse Groom'er. See GROOMER, p. 427, *supra.*

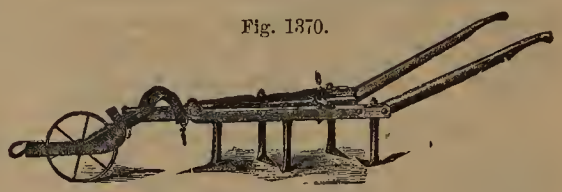
Horse Ham'mock. Used in shipping, transporting, and disembarking horses. In slinging, the canvas hammock is carried beneath the body of the horse and the cringles of the ends are carried to rings which engage the tackle-hook. Breast and breeching bands keep the horse from plunging out of the hammock.

On ship-board, the hammock is so suspended as to pass beneath the body of the horse, so as to catch him when he loses his feet in rough weather, and hold him till he recovers footing.

Horse Hoe. An implement for cultivating the ground between crops drilled in rows.

Fig. 1370 is a French horse hoe made by Meixmoron de Dombasle, of Nancy. It is a light form, an approximation

Fig. 1370.

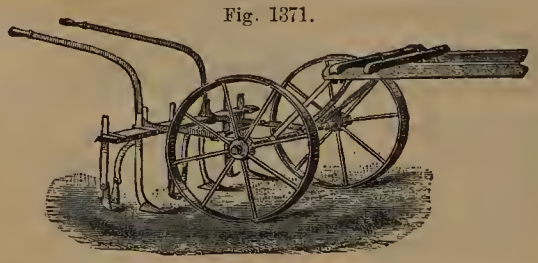


French Horse Hoe.

to the American, except in the shape of the hoes, which follows the English. The wheel in front regulates the depth, and the double adjustment by means of the perforated bars and pins gives command of the level or inclination of the frame. The latter is adjustable for different widths.

The implement shown in Fig. 1371 is also intended to follow drilled wheat, the hoes being carefully adjusted to the

Fig. 1371.



French Horse Hoe.

proper relative distance in accordance with the shares of the drill. The whole row of hoes is lifted or depressed by means of the handles.

See HOEING MACHINE, Fig. 2521, p. 1107, "*Mech Dict.*"
See also SCARIFIER.

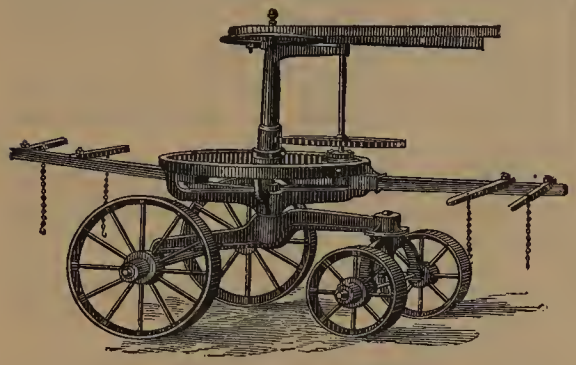
Horse Net. A net to protect a horse from flies.

Horse Pow'er. An apparatus for transferring the draft power of the horse to any machine.

Figs. 1372, 1373, 1374 show several French horse-powers, of moderate size. See also Figs. 2568–2571, pp. 1125–1127, "*Mech. Dict.*"

Fig. 1372 is a horse-power by *Girardin*, of Étampes (*Seine-et-Oise*). It is designed for two horses, and is used without dismounting.

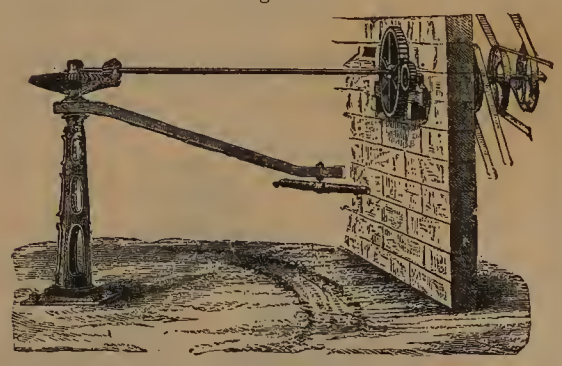
Fig. 1372.



Girardin's Mounted Horse-power.

The small horse-power with shafting, Fig. 1373, by Gautreau, of Dourdan (*Seine-et-Oise*), France, is founded on a column, the connecting-shaft going overhead. The horse-power stands on the outside of the building, and the power is transmitted by a bevel master-wheel and pinion, spur-

Fig. 1373.



Gautreau's One-horse Power.

wheel, and pinion to the pulley-shaft, which latter has a speed of 60 revolutions per minute with an ordinary speed of the horse which is attached to the sweep.

From the shafts in the building different *instruments d' intérieur*, as they are termed, are operated. Such are the straw-cutter, root-washer, root-cutter, grain-bruiser, etc.

The column is simply bolted to a foundation-plate or pillar, and the wall-gearing and shafting to a wall-plate, with but little expense of fitting, the work being simply to line and level the shafting in boxes already prepared and easily attached in place.

Fig. 1374 is another form of columnar horse-power, adapted for one or two horses. It is one of the lightest and cheapest forms.

The head is movable on the neck of the column, so as to direct the band-wheel in any radial direction from the column as an axis. It may thus be made to do duty with either one in turn of a numerous series of machines in a circular arrangement around the horse-power as a center, such as a chaff-cutter, root-cutter, corn-sheller, cider-mill, churn, or what not.

The speed-multiplier is an arrangement of spur-gears and pinions on the cruciform foot-frame, which is anchored or staked to the ground, or bolted to a floor.

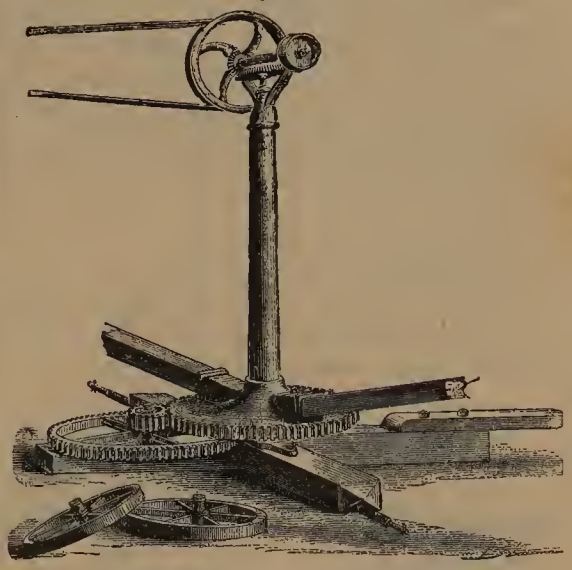
The pulley revolving in a vertical plane has one advantage over the horizontal pulley, as it allows the endless band to reach a machine whose driving-pulley is much below that on the column, whereas the horizontal pulley requires that the machines shall have a relative height.

It is transported by sufficiently elevating it to enable wheels to be slipped upon the spindles, which are shown projecting from the ends of two opposite bars of the cruciform frame. To one of the bars at right angles to the last stated is attached the tongue to which the team is geared for transporting the horse-power; or the tongue is attached to the rear of the thrasher.

The pulley-shaft may be prolonged by means of a coupling, so as to penetrate the wall of a building for the conveyance of power.

Refer to: . . . . . * "*Scientific American Sup.*," 771.
Crowley, Br. . . . . * "*Engineer*," 1. 192.

Fig 1374.



Gautreau's Two-horse Power.

Turner, Br. . . . . * "*Engineering*," xxiv. 68.
Pump, *Hayward* . . * "*Scientific American*," xxxiv, 243.
Pump, *Hill* . . . . * "*Scientific American Sup.*," 605.
Radway, *Emery* . . . * "*Am. Manuf.*," July 9, 1880, p. 12.
Stable floor, *Crawford* . * "*Scientific American*," xliii. 294.

Dr. Knight's report on Class 76 at the Paris Exposition of 1878, gives views and descriptions of the following horse powers and thrashers. See "*Paris Exposition* (1878) *Reports*," vol. v., pp. 167–183.

One-horse overhead horse-power	*Gautreau*	France.
Vertical horse-power with overhead-rod	*Gautreau*	France
Overhead columnar horse-power with band-wheel .	*Gautreau*	France.
Horse-power with ground-rod	*Gautreau*	France.
Hand-thrashing machine .	*Texier & Fils* . . .	France.
One-horse-power thrasher .	*Gautreau*	France.
Portable thrasher and mounted horse-power. .	*Gautreau*	France.
First-class thrasher . . .	*Ruston, Proctor & Co.*,	England.
Oblique-slotted beater for thrashers	*Gérard & Fils* . . .	France.
Band-cutting and self-feeding apparatus	*Marshall*	England.
Automatic feeder	*Ruston, Proctor & Co.*,	England.
Plan of safety-feeder. . .	*Ruston, Proctor & Co.*,	England.
Straw-stacker, rigged for use	*Marshall, Sons & Co.*,	England.
Straw-stacker, folded . .	*Marshall, Sons & Co.*,	England.
Complete English thrashing apparatus		England.
Section of straw-burning engine furnace	*Ransomes*	England.
Straw-burning engine . .	*Ransomes*	England.
Straw-burning portable engine	*Ruston, Proctor & Co.*,	England.
Huller for clover, lucern, etc.	*Brouhot & Co.* . . .	France.

Horse'-pow'er Com-pu'ting Scale. A pocket sliding scale for computing from the usual data, the indicated horse-power, size for power, etc.

The instrument consists of a simple double slide-rule, and will give the power of any cylinder from 4″ to 100″ diameter, working at from 1 lb. to 100 lbs. mean pressure, within about ½ per cent. of accuracy. By placing the scales in the necessary relative positions, they give, without calculation (1), the indicated horse-power from the usual data; (2) the size of engine for any given power; (3) the piston speed due to any stroke and number of revolutions per minute; (4) the ratio the high and low pressure cylinders of compound engines bear to each other; (5) the proportion the *mean* bears to the *initial* pressure, with the steam cut off at any given point in stroke. The instrument is $4\frac{1}{2}'' \times 2\frac{1}{4}''$.

Horse'-pow'er Jack. The intermediate motion of a horse-power, whereby the motion of the tumbling rod is transferred to a band-wheel shaft.

See JACK; INTERMEDIATE MOTION.

Horse'-pow'er Pump. A pump driven by animal power, as at *D*, Fig. 2569, p. 1126, "*Mech. Dict.*" The Oriental aud Spanish Norias (Na' Ura) are usually driven by cattle; the wheel with pots, as in Fig. 3333, p. 1533, "*Mech. Dict.*"; or the wheel with rope and pots, *a*, Fig. 3334, *Ibid.*

Horse'-pow'er Reg'u-la'tor. A device to limit the speed of the horse-power when work is suddenly withdrawn.

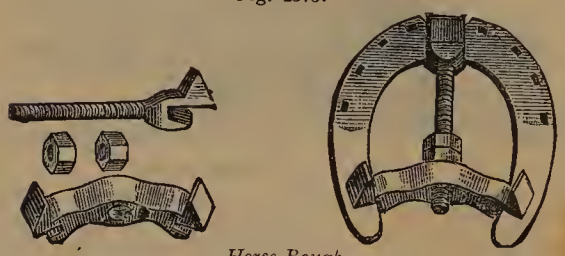
See GOVERNOR, Fig. 1230, Plate XIX.

Horse Rake. See HAY RAKE.

Horse Rough. A removable calk or stud to be attached to the shoe of a horse when traveling upon frozen ground or ice.

The Fig. 1375 shows, on the left, the pieces detached; on

Fig. 1375.



Horse Rough.

the right, the parts in position on the shoe. To be put on when leaving the stable.

Another form is studs with screw shanks, which screw into holes tapped into the shoes.

Horse Shoe. A horse shoe of raw hide is composed of three thicknesses of cow-hide compressed into a steel mold and then subjected to a chemical preparation. It is light, lasting, elastic, aud requires no calks, even on asphalt.

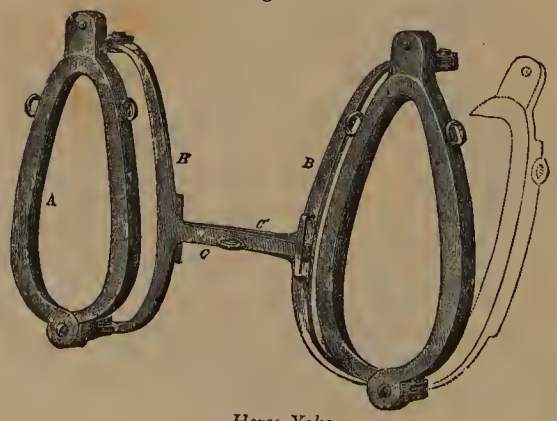
Refer to: —

Billings	* "*Scientific American*," xl. 53.
McVeen	* "*Am. Man.*," Mar. 7, 1879, p. 12.
Potvin	* "*Scientific American*," xliii. 18.
Thistlewood	* "*Scientific American Sup.*," 240.
And swage, *Stephenson*	* "*Scientific Amer.*," xxxiv. 355.
Bender, *Ray*	* "*Scientific American*," xxxv. 51.
Calk, *Thistlewood*	* "*Iron Age*," xx., Nov. 8, p. 20.
Hoof cushion	* "*Scientific American Sup.*," 2835.
Nails, manufacture of, "Globe"	* "*Scientific American*," xl. 127.
Nail machine, *Sheridan*	"*Scientific American*," xli. 88.
Steel, *Williams*	"*Iron Age*," xix., April 19, p. 11.
Weighted, *Seixas*	* "*Scientific American*," xlii. 102.
	* "*Iron Age*," xxv., April 15, p. 9.

Horse'-shoe Ham'mer. See FARRIER'S HAMMER; TURNING HAMMER; TURNING SLEDGE, etc. See list under HAMMER; SLEDGE.

Horse'-shoe'er's Ma-chine'. A foot-vise with treadle and toggle. The shoe is gripped by

Fig. 1376.



Horse Yoke.

placing the foot on the treadle, and the vise falls open when the foot is removed. The dies in the jaws of the vise are so shaped to give the right form to the calk as it is hammered. An anvil attachment is used for trueing up the shoe; it carries a steel die with four different-sized slots for welding on calks. See ANVIL VISE, Fig. 97, p. 42, *supra.*

Horse'-shoe Stud. A calk secured into the horse-shoe.

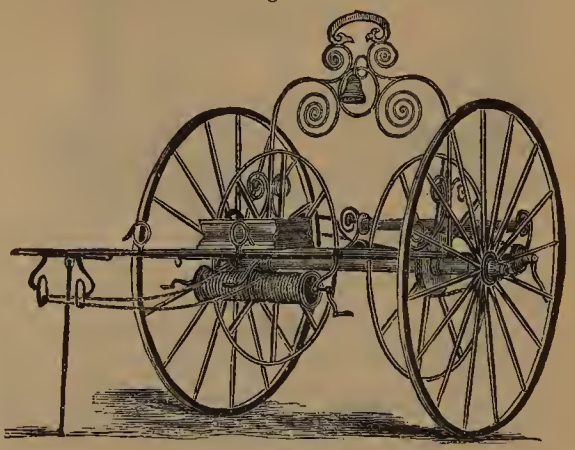
Horse Yoke. (*Agric.*) A pair of hames, *A A*, Fig. 1376, slipped upon the usual collars, and each consisting of two hinged portions to clasp upon the neck; the two hames connected by sectious *B B* and a brace, *C*; the latter having a ring to which the draft chain is attached. Practically, a return to the most ancient method of harnessiug. See Fig. 1251, p. 528, "*Mech. Dict.*"

Hose. Flexible pipe for conveying fluids.

Hose-carriage, *Aiken*	* "*Scientific American*," xlii. 275.
Miller	* "*Scientific Amer.*," xxxiv. 262
Coupling	* "*Scientific Amer.*," xxxviii. 182.
Hofmann	* "*Scientific American*," xli. 15.
Price	* "*Scientific American*," xxxv. 383.
Coupling, wedge, *Galvin*	* "*Am. Man.*," July 25, 1879, p. 12.
Nozzle, variable, *Leggett*	* "*Iron Age*," xxi., Jan. 17, p. 3.
Nozzle, *Palmer*	* "*Scientific American*," xli. 395.
	* "*Scientific American*," xlii. 54.
Pipe	"*Scientific American*," xli. 320.

Hose Cart. A two-wheeled vehicle for transporting hose. It has arrangements for winding the hose upon the drum, and allowing the hose to

Fig. 1377.

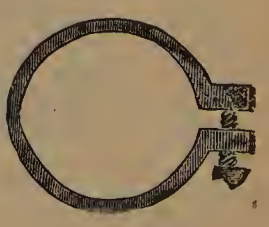


Balanced Hose-cart.

pay off when required. It is shown in Fig. 1377, with a tongue for the fireman and a cord for the string of men by whom it is drawn.

Hose Clamp. A band which can be tightened upon a hose to sustain a weak part or stop a leak.

Fig. 1378.



Hose Clamp.

Hose Nip'ple. A short pipe, externally threaded at each end; on to one end the hose is firmly bound by lashing, the other affords junction for another section of hose or for the nozzle.

Hose Screw. The brass or gun-metal coupling for hose sections. See HOSE COUPLING, Fig. 2582, p. 1132, "*Mech. Dict.*"

Hose Sprink'ler. A rose ou the end of a uozzle to give a fiuc spray of water.

Hose Truck. A small hose-carriage for carrying hose for domestic and garden use, washing carriages, etc.

See Fig. 2575, p. 1132, "*Mech. Dict.*"

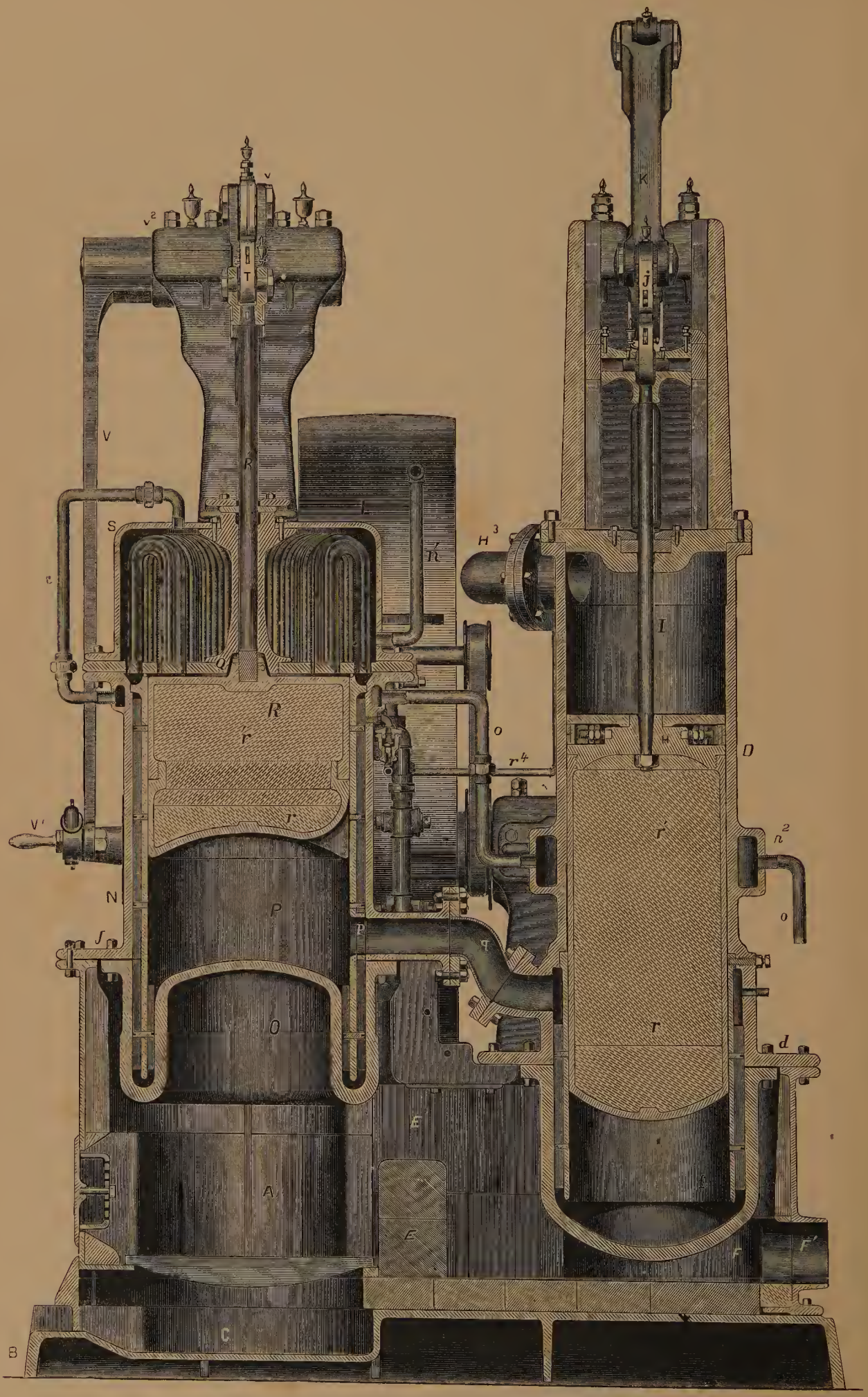


PLATE XXI HOT-AIR ENGINE. (WOODBURY, MERRILL, PATTEN & WOODBURY.) *See pages* 467-469.

Hose Un'ion. See HOSE COUPLING, "*Mech. Dict.*," Fig. 2582, p. 1132.

Another name for the screw coupling.

Hose Un'ion Cap. A cover to close the end of a hose; a cap screwed upon the coupling at the end of the line of hose.

Hose Wrench. A spanner for coupling and uncoupling sections of hose.

Ho'sier-y Seam'ing Ma-chine'. A machine for sewing together knitted goods.

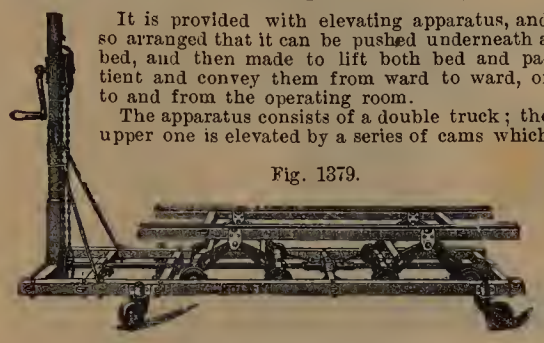
The loops of the respective pieces are slipped on to holding pins and are sewn together by a chain-stitch. The reciprocating eye-pointed needle puts a loop of yarn through the loops of the knitted fabric, the needle-yarn being caught by a reciprocating hook, which detains it while the needle retires; the goods are then fed along the distance of a stitch and the needle repeats the movement. The feed is by a rack-movement.

Hos'pi-tal-bed El'e-va'tor. A truck, devised by Dr. Morton, for surgical wards especially.

It is provided with elevating apparatus, and so arranged that it can be pushed underneath a bed, and then made to lift both bed and patient and convey them from ward to ward, or to and from the operating room.

The apparatus consists of a double truck; the upper one is elevated by a series of cams which

Fig. 1379.



Hospital Bed-elevator and Truck.

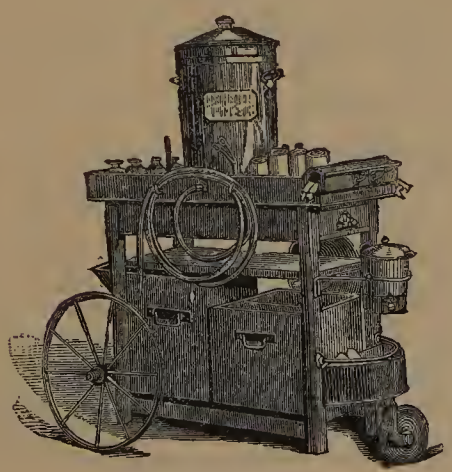
run upon a narrow iron track; a long right-and-left screw, worked by an endless chain upon a crank at one end, raises and depresses the cams. 400 lbs. can be lifted quite free from the floor in 4 seconds; and without difficulty a water-bed, which weighs about 700 lbs., with patient, can be elevated and readily moved. The elevation of the bed an inch or so from the floor is all that is required.

Invalid bed, *Graff*. . . * "*Scientific American*," xl. 403.

Hos'pi-tal Ward Car'riage. An invention of Dr. Morton for conveying all the necessary appliances for dressing the wounds or sores of the patients in a surgical ward.

It is a truck on 3 gutta-percha rimmed wheels, carrying a table, elevated water reservoir, and hose, the necessary pans, etc. On either side of the water-can appropriate places are partitioned off for the bandages, charpie, oiled silk, adhesive

Fig. 1380.



Hospital Ward Carriage.

plaster, and jars for holding the lint soaked in the various solutions commonly used for ward applications; drawers are placed in each end and serve as receptacles for towels, instruments, etc, etc. One large bucket, with a projecting lip, occupies one half the space under the table, into which all the refuse dressings, poultices, soiled water, and oakum, from each patient, are emptied. Another can, with two compartments, adjoins the bucket; into one of these the soiled bandages are thrown, while the other carries the fresh oakum, cotton batting, muslin, and old linen, used for the ordinary ward purposes.

One good-sized basin serves for the entire ward or series of communicating wards, since it serves merely as the receptacle for the water and discharges flowing from the part during the process of dressing. A can for hot water, for heating the adhesive plaster, completes the apparatus, which is pushed to the foot of each bed; the length of the gum-elastic tube and the elevation of the supply of water allow the stream to be carried to any part of the patient which requires cleansing, in either the recumbent or sitting posture.

Hot'-air En'gine. The subject of hot-air engines falls under several heads, as inventors have chosen names which have been accepted and become established. In the "*Mechanical Dictionary*," 11 pages have been devoted to AIR ENGINES, nearly all of which work by increase of pressure derived from increment of heat.

The *caloric* engine of Ericsson was described in pp. *40, 41, "*Mech. Dict.*," and a later very compact form at Figs. 510, 511, p. 155, *supra*. See references *passim*.

The *compression* engine of Rider is shown at Fig. 674, p. 216, *supra*.

One of the earliest, and certainly simplest, though not important, except as one may care to gather up all the items in the history of an art, is the English patent of Joseph Hately, 1775 of 1790, in which he proposed to utilize the force of a current of rarefied air escaping from a chimney against vanes. A smoke-jack.

Cooling arrangements for cylinder, Engl. Pats., Boulton, 1,636 of 1864; 501 and 827 of 1865.

C. W. Siemens, Engl. Pat., 2,074 of 1860, uses 4 working cylinders with communication through regenerators. A mixture of air and inflammable gas is introduced into the chambers through pipes. Cylinders cooled by currents of cold water. See 326 of 1852; 1,363 of 1856.

Woods's Engl. Pat., 739 of 1859. Air heated by passing through pipes conveyed to a cylinder under pressure.

See also Engl. Pat., Young & Kirk, 227 of 1864 Two displacing cylinders above the engine. The upper parts heated by steam jackets; the lower cooled by water. The pistons drive the air alternately from one to the other.

Mennon's, 218 of 1862. The piston of a single-acting engine is adapted on one side to draw in air and force it to the heating surface; on the other side is exposed to the motive power of the heated air. The capacity of the cylinder on each side is proportioned.

Wenham's hot-air engine (English) The air is heated in a closed combustion chamber by direct contact with the fuel, and passes with the gases evolved into the cylinder. The cylinder is single acting, the upper part of it being arranged to serve as an air pump, and there is the usual regenerator for economizing fuel.

The feature of burning under pressure and sending the gaseous products of combustion to the cylinder is found in the U. S. patents of Bennett, 1838, and Washburn, 1865 In fact it was the feature of Oliver Evans's "volcanic engine," about 1786.

The hot-air engine of Woodbury, Merrill, Patten & Woodbury is shown in elevation in Fig 1381 and in vertical section in Plate XXI.

The essential features are a heater, regenerator, and cooler, which three, in combination, are termed a *reverser*, and in conjunction with a working cylinder, constitute a single-acting engine. The illustrations represent a double-acting engine, with two reversers and two working cylinders. These in a machine of the size represented are of the following sizes:

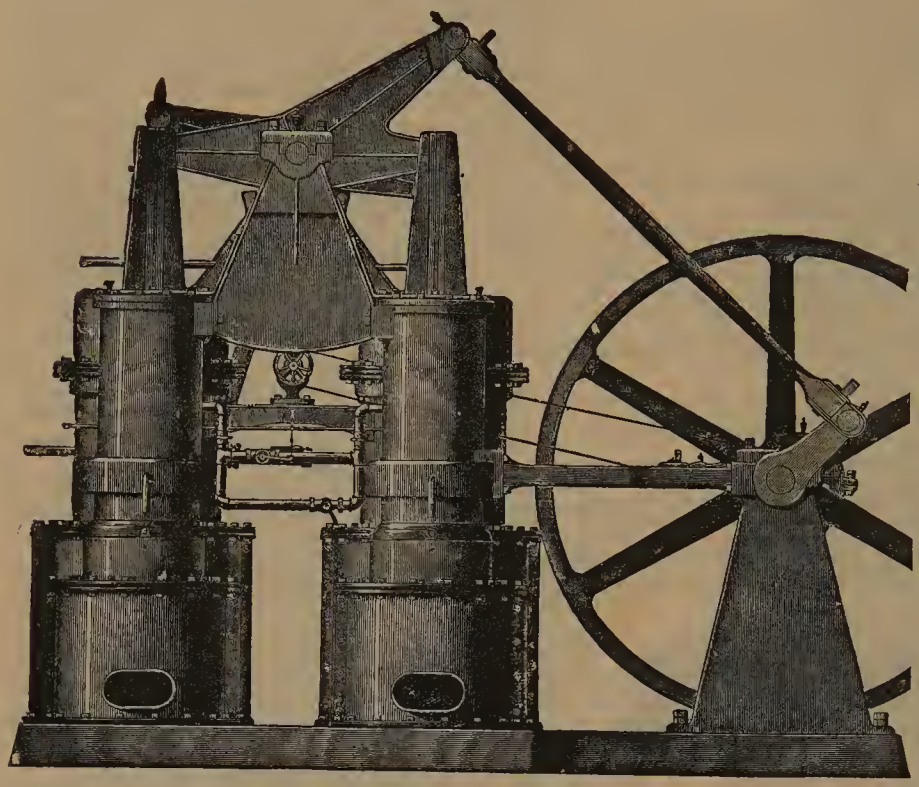
Working cylinders . . 10″ diameter . . 2′ stroke.
Reverser cylinders . . 20″ diameter . . 1′ stroke.

The air is heated and cooled on each revolution; and the rapidity with which this is effected is one of the chief objective points in machines of this character. The cooling process is performed by the circulation of water around small thin copper tubes through which the air passes.

The following statement explains the principle of the machine in the words of the inventors: —

In a machine of the size above referred to, "the displacer pistons or reverser pistons change 4,000 cubic inches of air from the hot end to the cold end by one displacer, and 4,000 cubic inches from the cold end to the hot end by the other displacer, each stroke of the engine, the engine being a double cylinder, or practically a pair of engines. In this way 8,000 cubic inches are heated and cooled by each stroke of the en-

Fig. 1381.



Hot-air Engine.

gine, or 16,000 cubic inches moved at each revolution, and of this amount 8,000 is heated and 8,000 cooled at each revolution, or at 100 revolutions per minute, which was the speed of the engine in its regular work in the Institute Fair [Mass. Manuf. & Mech. Inst. Fair, Boston, 1881], 800,000 cubic inches are heated to a differential temperature of at least 400° Fah, and this is probably lower than actual practice. It is well known that atmospheric air at 30″ barometric pressure requires 13 cubic feet to weigh one pound avoirdupois, hence 800,000 cubic inches equals 470 cubic feet; 470 divided by 13 equals 36 lbs., which are heated to 500° Fah. every minute when working under 1 atmosphere of pressure, and at 4 atmospheres pressure 144 lbs. of air are heated to the same temperature. Actual experience with this motor has proved that the actual consumption of coal has not exceeded 400 lbs. in 10 hours, or 40 lbs. per hour. Per minute the consumption is one sixtieth of forty or two thirds of 1 lb per minute, and 144 lbs. of air is heated to a differential temperature of at least 400° Fah., with the combustion of two thirds of 1 lb. of fuel. It may take somewhat more heat to heat the air working under 4 atmospheres density, but it has not been realized in actual practice, or in practical work, and this practical experiment has proved that so long as the air is confined in a given space the rapidity and facility of its heating is not approximately different whether 1 atmosphere is worked or 4 atmospheres are worked; but the power developed by 4 atmospheres is enormously different in deuse air from that obtained by using air under simply the natural atmospheric pressure. With 1 atmosphere the engine indicates 8 horse-power; with 4 atmospheres it indicates 26 horse-power, and in either case three quarters, at least, of the indicated horse-power is transmitted by the fly-wheel, the balance being absorbed in the friction of the engine, passing the air through the parts and running the water and air pumps. The cooling requires some 15 gallons of water per minute, the water weighing 8 lbs. 3 oz. per gallon; 15 gallons weigh 123 lbs., and this amount is required to cool 36 lbs. of air when working 1 atmosphere, and in working 4 atmospheres' density 144 lbs. of air are required, and the cooling water is raised in temperature about 20° Fah. above its normal temperature in passing through the coolers."

In Fig. 1381, which is a side elevation of the engine, the working cylinders (the smaller) are seen in front and the reverse cylinders behind.

In Plate XXI. the section passes through one working and one reversing cylinder, the connections, fire pit, bridge wall, and flue being one half of the engine as shown in Fig. 1381, the other half being precisely similar, making up a full double-acting engine with 4 cylinders having 2 working cylinders and 2 reversers. *A* is the fire-box or furnace mounted upon a bed plate and provided with the grate, ash-pit *C*, and the usual fire door. The fire-box casings extend to the rear of the combustion chamber, sufficiently far to serve as supports for the working cylinder, *D*; the rear portion being partially separated from the combustion chamber by the bridge wall *E*, above which the products of combustion pass through the flue *E′*, across the chamber *F*, and thence escape into the chimney through the passage *F′*. The working cylinder *D* is cast open at both ends and provided at its lower end with broad flanges, the outer portion of which rests upon and is securely bolted to the casing *A*, while to the inner portions of the same flange of the cylinder is bolted the fire-pot or heater. The lower portion of the cylinders, *D*, is made of somewhat greater diameter than the upper portion, and has fitted thereon the short secondary cylinder or shield *f*, the lower end of which extends down into the heater to within about an inch of the bottom, leaving space sufficient for the air to pass by under the piston in the working cylinder. The object of this is to force the air against the surface of the heater. The head at the upper end of the cylinder *D* has an opening for the passage of the piston-rod *I*, and two cupped packing rings to prevent the escape of air around said rod, the upper end of which is connected by the link *J* to one end of the beam *K*, which is also connected to the crank upon the driving shaft, mounted in bearings upon standards carrying the driving pulley *L*. The two chambers above the pistons are connected by the pipe *H*[3].

N is the cylinder of the reverser, provided with a broad flange, *j*, at its lower end, the outer portion of which rests upon the furnace casing *A*; to the lower end of the cylinder is bolted a curved heater, *O*, which is placed directly over the fire-grate for the purpose of receiving the direct radiation of the fire against its sides and bottom. *P* is the reverser cylinder, made of somewhat less diameter, and placed within and concentric with the cylinder *N*, with its lower end extending down into the curved heater within about an inch of the bottom, in such a manner as to form an annular chamber between the cylinders *N* and *P*, to serve as a regenerator. The upper ends of the cylinders *N* and *P* are closed by the head *Q*, which is firmly bolted to the cylinder *N*, and rests upon a rubber packing ring placed in a groove in the upper end of the cylinder *P* to form an air-tight joint and allow for unequal expansion.

The head *Q* has, set therein and projecting upward therefrom, a series of ∩-shaped pipes, one end of each of which communicates with the space between the cylinders *N* and *P*, and the other end with the interior of the cylinder *P*, above the reverser piston *R*, and is also provided with a central upwardly projecting tubular hub through which the piston rod *R′* passes, and to the upper end of which is secured the upper end of the cooler casing *S*, the lower end of which is firmly bolted through the head *Q* to the cylinder *N*, thus forming a cooling chamber inclosing the ∩-shaped pipes, which chamber is to be filled with circulating cold water.

The upper end of the piston rod *R′* is connected by the link *T* to the beam *V*, upon one side of the standard, in which said beam has its bearings, while said beam is connected upon the opposite side of said bearing by another link and piston rod to the reverser piston in the second reverser cylinder, which is constructed in all respects like the one just described.

The pistons *H* and *R*, of the working and reverser cylinders respectively, are each cast in two parts and screwed together so as to form hollow air-tight chambers therein, the lower portion of each of which is filled with fire-brick *r′*, and the upper portion with asbestos, *r′*. The beam center

has firmly secured to its outer end the pendent arm V, provided with a pin V', by means of which the beam and the reverser pistons may be worked by hand to start the engine, or by means of a hook connecting-rod and crank the beam and pistons may be worked by the power.

Air may pass freely by pipe $p\ q$ from the interior of the reverser cylinder to the annular space, in the working cylinder and down against the heater of the working cylinder, to the space beneath the working piston H, and *vice versa*, as the motion of the piston may be either up or down.

An automatic bye-pass valve in a pipe, the ends of which open into both reverser cylinders, is used to equalize the pressure between the two reverser cylinders, and regulate the motion of the engine in proportion to its load.

An eccentric on the main shaft of the engine drives a small air-pump for the purpose of compressing air up to any density required; and connecting by means of r^4, with two vertical check-valves self-operating, which admit the air under pressure into the engine as required.

The water for circulation in chamber S to cool the air in the ∩-shaped pipes, is driven by a plunger pump, shown erect over pipe p. It enters S by means of pipe n', and issues by pipe o to an annular chamber around the cylinder D at n^2, where it serves as a cut-off for the heat ascending the working cylinder, above that point against which the piston moves.

The operation is as follows: The beam being in motion, the effect is that the pistons in the reversing cylinders displace the air contained therein, by driving the air in the cold end of one of the said cylinders through the ∩-shaped tubes in chamber S, and the regenerator space between cylinders P and N into the heater; at the same moment driving the air in the hot end of the other reverser cylinder through the heater and the regenerator space into the tubes n, thereby greatly increasing the pressure on one reverser cylinder, and in the lower end of one working cylinder, and correspondingly diminishing the pressure in the other reverser cylinder and the lower end of the other working cylinder with which it communicates. The increase of pressure beneath one of the working pistons causes it to be worked upwards till it reaches the extreme of its upward stroke, when the reverser pistons change their position, thereby diminishing the pressure beneath the working piston which has just completed its upward stroke, and increasing it beneath the one that has just completed its downward stroke, thus creating a differential pressure beneath the two working pistons, by means of which the engine is driven, the pressure alternately changing from one cylinder to the other.

The power of the engine will be determined by the difference in the pressure alternately created in the reverser cylinders by the movements of their pistons, heating the air in one reverser cylinder and cooling it in the other, thereby at each stroke of the engine increasing the pressure beneath one working piston and diminishing it beneath the other working piston.

See also: *Hock & Martin*	* "*Scientific Amer.*," xxxvii. 6.
Pumping, *Rider*	* "*Scientific Am.*," xxxviii. 131.
	* "*Scientific Amer.*," xxxiv. 66.
Rider	* "*Engineering*," xxii. 33.
	* "*Scientific Amer. Sup.*," 768.
	* "*Polytechnic Review*," ii. 175.
	* "*Manuf. and Builder*," ix. 7.
	* "*Railroad Gazette*," xxiv. 189.
	* "*Amer. Artizan*," No. 12, 1874.
Sachsenberg	* "*Scientific Amer. Sup.*," 2579.
"Tom Thumb"	* "*Scientific American*," xlii. 373.
Van Rennes, Holland	"*Iron Age*," xxii., Sept. 5, p. 15.
Van Rennes	* "*Scientific Amer. Sup.*," 3931.
Woodbury, Merrill & Patten	* "*Engineering*," Jan. 13, 1882.

Hot'-air Pump'ing En'gine. The application of the hot air engine to pumping is the particular purpose of some of the small motors of this class. See Fig. 510, p. 155, and Fig. 674, p. 216, *supra*. See also HOT-AIR ENGINE.

Hot'-air Reg'is-ter. A valve, usually a centrally pivoted circular plate with openings, moving upon a perforated plate at the opening of a hot-air flue. By bringing the openings in the two plates into correspondence or otherwise, the air is allowed to pass, or is shut off, respectively.

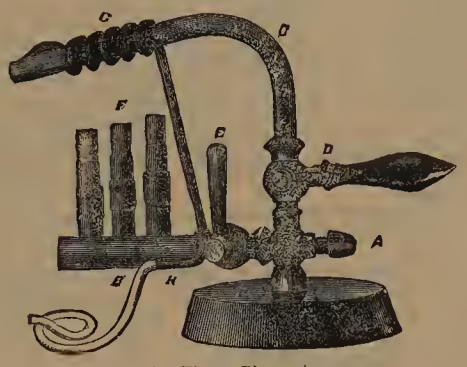
Hot'-air Stove. See HEATER; STOVE.

Hot'-air Syr'inge. A syringe with a chamber which heats the passing air. Used to dry cavities in teeth before filling. See CAVITY DRYER, Fig. 572, p 179, *supra*.

Hot'-blast Blow'-pipe. A substitute for the ordinary blow-pipe.

The gas tubing is attached at A, allowing the gas to pass into both the upper and lower tubes, $B\ C$, and the supply can be regulated by the stop-cocks $D\ E$. The burners F heat

Fig. 1382.



Hot Blast Blow-pipe.

up the wire coil G, through which the breath passes, and it is thus thrown upon the surfaces to be acted upon in a heated condition. The mouth tubing is attached at H.

Hot'-blast Ov'en. (*Metallurgy.*) The Siemens' system, and modifications by Cowper and Whitwell are superseding the Player stove. *B*, Fig. 2588, p. 1134, "*Mech. Dict.*" See GAS FURNACE, where the Siemens' regenerator is shown, Cowper's and Whitwell's are referred to, on page just stated. See HOT-BLAST STOVE.

Hot'-blast Stove. Weimer's hot-blast stove, Lebanon, Pa., is shown in Fig. 1382. Its most important features are the suspension of the pipe from the roof of the stove, and the absence of the usual bed-pipes or mains.

The pipes are V-shaped, the cross section an ellipse $4'' \times 12''$ internally, and united by end flanges. The inlet main rests on the top end wall of the stove, and is provided with an inlet branch and three pipe branches; three rows of U pipe (three to a row) convey the air to be heated from the

Fig. 1383.

Hot-blast Stove. (*Lebanon, Pa.*)

inlet main through the first heating chamber to the transfer main, resting on the opposite side of the stove, where it is transferred to a similar lot of pipe, which convey it through chamber No. 2 to the outlet main. Each stove has two independent combustion chambers communicating each with its separate pipe chamber for the purpose of enabling the attendant to throw as much gas, and consequently heat, into the "cold" side of the stove as may be desirable, and to check a too great accumulation on the hot side. Each pipe is suspended by means of two key bolts to a 15′′ wrought-iron beam, three of which traverse the top of the stove resting on wall plates. Four draft chimneys on the corners of the stove control the action of the upper pipe chambers, while the usual gas valve regulates the flow of gas to the combustion chamber.

The oven contains 18 pipes, 20′ long, the heating surface of each pipe 109 square feet.

The fire-brick stove of Whitwell, of Stockton-on-Tees, England, is intended to heat the blast of iron furnaces, and is shown in Plate XXII.

Fig. 1 is a vertical section.

Fig. 2, a horizontal section.

Fig. 3, an enlarged vertical section of the hot-blast valve, *B*, and its adjuncts.

Fig. 4 shows by an enlarged section the chimney valve, *C*, and cold-blast valve *J*.

Fig. 5 shows two ovens in elevation and the furnace in vertical section.

Fig. 6 is a plan of four ovens and a blast furnace.

The stoves are designed to replace the ordinary iron pipes used for heating the blast, substituting for them a series of fire-brick chambers and passages, which are heated by the direct contact of the flames of the burning gases taken from the furnace in the usual way. When the mass of brick is sufficiently heated the gas is shut off and the blast is admitted, and this, in passing through the same heated chambers, acquires the temperature of the bricks. The brick-work gradually cools down, but, by the time the last chamber begins to be too cool another stove has been heated up, and the blast is made to pass through that. The stoves are thus alternately heated by the burning gas and cooled by the blast. The advantages of this system are numerous. One of the greatest is uniformity of temperature of blast, which cannot be counted upon with iron pipes. The bricks are a great store-house of heat, and cool gradually. Iron pipes cool suddenly when, from any cause, the supply of burning gas is stopped. The air being brought into direct contact with the surfaces previously heated by the gas, absorbs the heat quickly and with little loss. The apparatus is simple, is easily erected, and is being extensively introduced. For cupola-furnaces, making 600 tons a week, two stoves, 12′ square by 21′ high, and with 2,270 superficial square feet of heating-surface in each, are necessary.

In heating the stove, the hot-blast valve, *B*, and the cold-blast valve, *J*, being closed, the gas-valve, *A*, is opened, through which the gas enters the stove, traverses up and down the spaces between the upright walls, and enters the chimney-flue by the valve, *C*. Heated air is supplied to the gas by means of the air-valves *a* and *c* and passages *b* and *d*, by which a most intense combustion is gained. The internal heat of the stove, as well as the combustion of the gas, is observed by the eye-pieces *e e*.

In heating the blast, the chimney-valve *C* and gas-valve *A* being closed, and the hot-blast valve *B* being opened, the cold blast is admitted through the cold-blast valve *J*, and issues from the stove by the valve *B*, red hot, all other valves being closed perfectly tight.

In cleaning the stove, the top cleaning-doors, *F*, are opened and the walls scraped with the cleaning-tools, when the dust deposited on the heating surfaces falls to the bottom of the stove, and is removed by the bottom cleaning-doors, *D*.

The general duty of one stove is 100 tons of pig iron per week: the average temperature of the blast, 1400° Fah. by Siemens' pyrometer.

See also: Mode of action, *Bell* . . . . . "*Iron Age*," xvii., Jan. 20, p. 7.
"*Iron Age*," xvii., June 29, p. 1.
History and data . . . * "*Iron Age*," xxiv., July 31, p. 1.
Stove, *Cowper*, Br. . . * "*Engineer*," xlix. 361.
* "*Scientific American Sup.*," 714.
Crossley, Engl. . . . . * "*Iron Age*," xvii., Mar. 23, p. 1.
Furnace, *Holcomb* . . . * "*Sc. American*," xxxviii. 390.
Cupolas, *Kirk* . . . . * "*Iron Age*," xxi., Feb. 14, p. 5.
Regenerators . . . . . * "*Sc. American Sup.*," 3738, 3739.
Stove, *Mills*, Midland furnace, Mobile . . . * "*Engineering*," xxii. 413.
Stoves, on, *Mills* . . . "*Van Nostrand's Mag.*," xv. 165
Stove, *Mills* . . . . . * "*Eng. & Min. Jour.*," xxii. 119.
Stoves, *Siemens-Cowper-Cochrane* . . . . . * "*Iron Age*," xxiii., May 1, p. 1.
Boiler furnace, *Stribling* * "*Scientific American*," xxxv. 4.
Stove, *Weimer* . . . . * "*Engineering*," xxii. 214.
* "*Eng. & Min. J.*," Oct. 28, 1876
Oven, *Weimer* . . . . * "*Iron Age*," xvii., Apr. 27, p. 19.
* "*Iron Age*," xviii., Aug. 3, p. 1.
* "*Iron Age*," xx., Dec. 13, p. 1.
* "*Iron Age*," xxv, April 22, p. 1.
Tuyere, *Westwood* . . * "*Engineer*," xlvi. 164.
Stove, *Whitwell* . . "*Iron Age*," xix., June 7, p. 5.
Whitwell; Cowper . . * "*Scientific American Sup.*," 714.
Blake's "Report, Vienna Exposition," iv., § E, p. 225.

Hot Cast Por'ce-lain. (*Glass.*) A name given to an opalescent glass made in Philadelphia of

Cryolite	10.
White sand	20.
Oxide of zinc	20.

See CAST PORCELAIN, p. 177, *supra*; CRYOLITE, p. 233, *supra*.

Hot Curv'ing Ma-chine'. A machine for bending laterally a hot-rolled rail to suit a curve of any given radius. See also CAMBERING MACHINE, which gives the required vertical curve, as at the summit and foot of inclines.

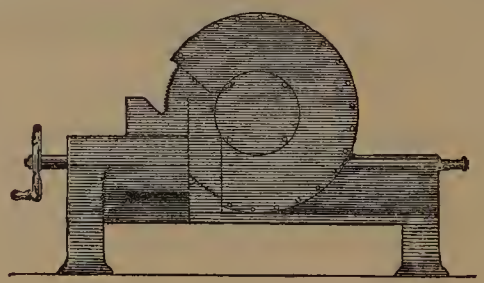
Gustin . . . "*Engineering*," * xxix. 372, Fig 7

Hot-i'ron Saw. A saw which removes fag end or superfluous length from a rolled rail or bar while yet hot from the rolls.

The hot saw used at the Landore Siemens Steel Company swings in a frame so as to be moved to the rail, and is shown, Fig. 17, p. 14, vol. xlii., "*Engineer*."

The apparatus has a strong cast-iron frame, a grooved bed

Fig. 1384.



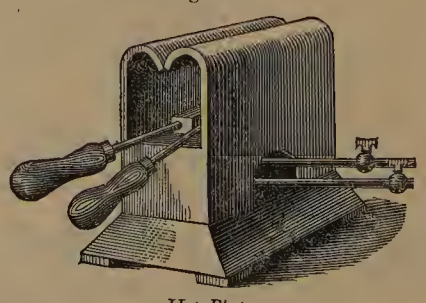
Whitworth's Saw for Hot Iron.

for holding the iron to be cut; the saw is drawn towards the iron by screw traverse. See also IRON SAW.

Iron saw, *Claridge*, Br. . . * "*Engineer*," xlvii. 201.
Bloom shear, Springfield, Ill. . * "*Engineering*," xxix. 371.

Hot Plate. A gas stove for heating copper bits for soldering.

Fig. 1385.



Hot Plate.

Hot Press. A machine in which pressure is aided by heat, either in calendering or expressing; the former for paper and fabrics, the latter for stearine and oils.

The stearine hot press of Morane, Paris, is shown in Fig. 1385. It has a hydraulic cylinder and pressure piston at one end, and a movable abutment at the other. The bags of material are sandwiched between hollow plates of iron, steam-heated by means of the pipes and flexible connections, the said pipes also serving to suspend the heated plates when the pressure is slackened in order to remove the cakes of

WHITWELL'S
PATENT HOT BLAST STOVES.

FIG. 1.

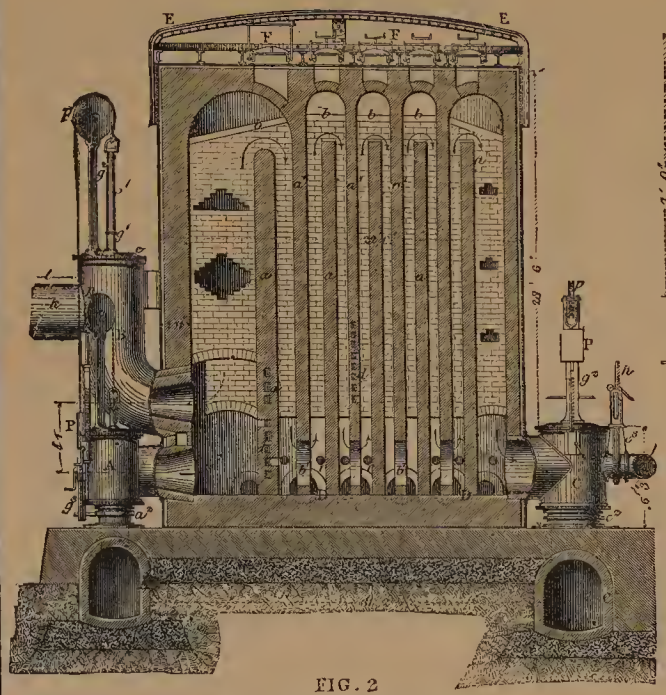


FIG. 3.

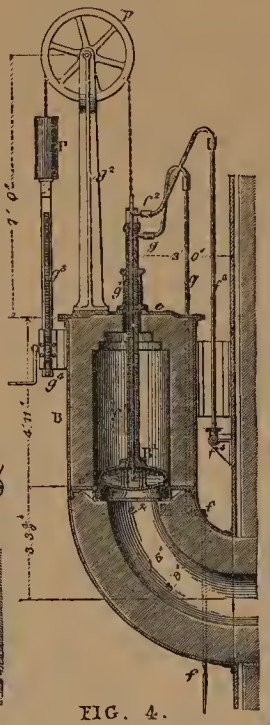


FIG. 5.

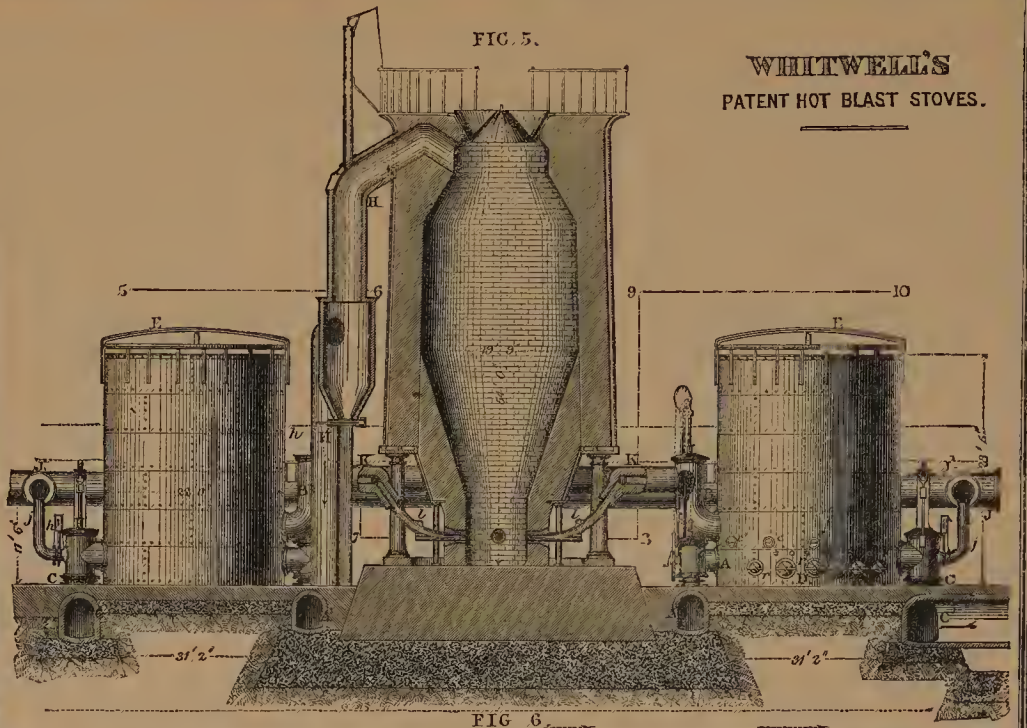


FIG. 2

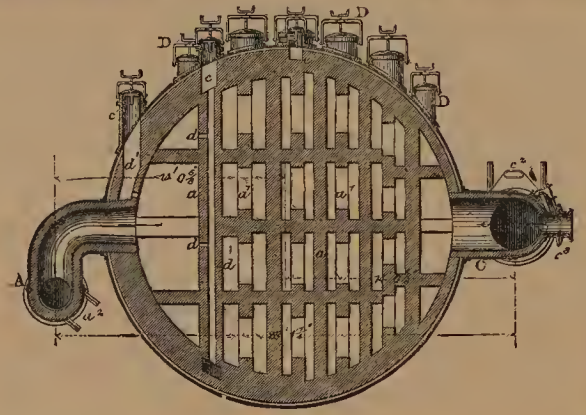


FIG. 4.

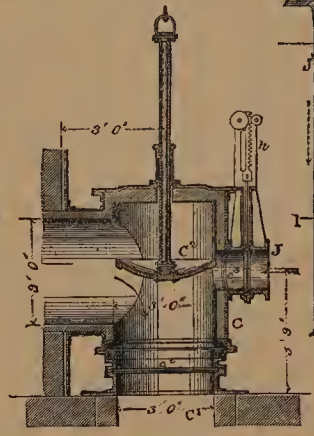


FIG. 6.

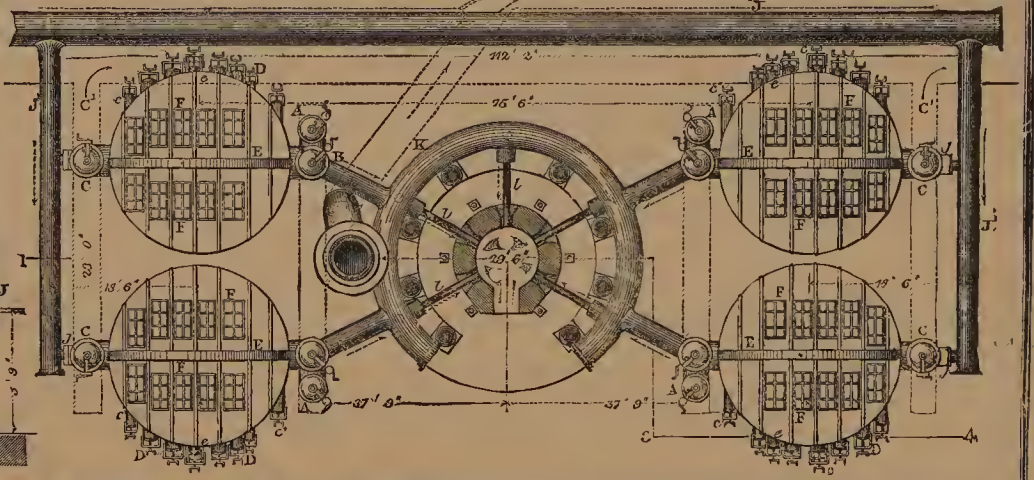
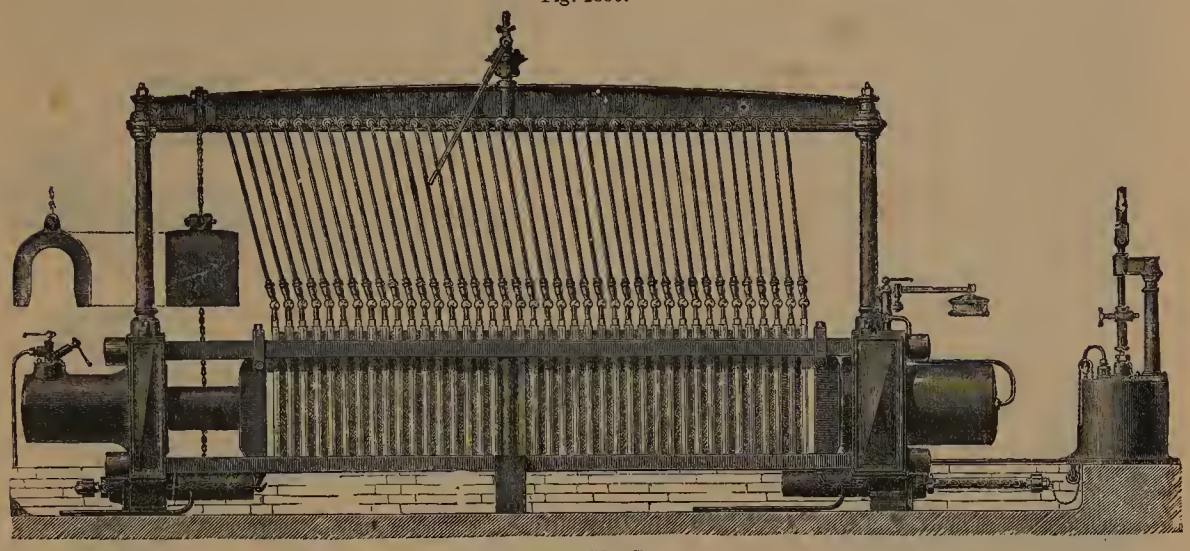


Fig. 1386.



Stearine Hot Press.

stearine. Forty bags form a charge. The slack pressure (*suppression des espaces nuisibles*) takes 3 seconds; the completion, 17 seconds; total, 20 seconds. The pressure, 800 kilos. Production, 600 kilos. stearine saponifiée. The press is self-arresting when the required pressure is reached.

Hot Saw. See HOT-IRON SAW; IRON SAW.

Hot Straight'en-ing Ma-chine'. An apparatus to receive rods or bars from the rolls and straighten them perfectly by stretching before cooling.

At the end nearest to the rolls is a clamp-head or head-stock, which slides in a U-shaped groove. At the other end of the bed, which is long enough to allow the working of bars about 80′ in length, is another sliding head, the tail-stock, which can be moved by hand along the whole length of the bed, as may be required by the various lengths of the bars to be straightened. It runs on two wheels on a rail.

The machine is operated as follows: One end of the hot bar, as it comes from the rolls, is firmly clamped in the head-stock, while the other end is secured in the tail-stock, which is so constructed that simultaneous with the clamping of the bar the tail-stock is firmly fastened to the bed-plate so that it cannot slip. Power is then applied and the slide is dragged forward with an intermittent, jerky motion, which rapidly straightens the bar and stretches it, the proper limit being determined by the operator. The clamps are released and the bar is slipped on to the adjoining hot-bed, where it is allowed to cool.

Baldwin . . . . . * "*Iron Age*," xxiv., Oct. 16, p. 1.

Hot Water Heat'er. A device for warming buildings, conservatories, etc., by means of a circulation of hot water in pipes. See HEATER, *supra*, Also p. 1136, "*Mech. Dict.*"

Hound Plate. A bracing plate at the junction of the fore end of the wagon hounds with the coupling.

Hour Glass Coil. A heating coil larger at the ends than at the mid-length, resembling an hour glass in exterior outline.

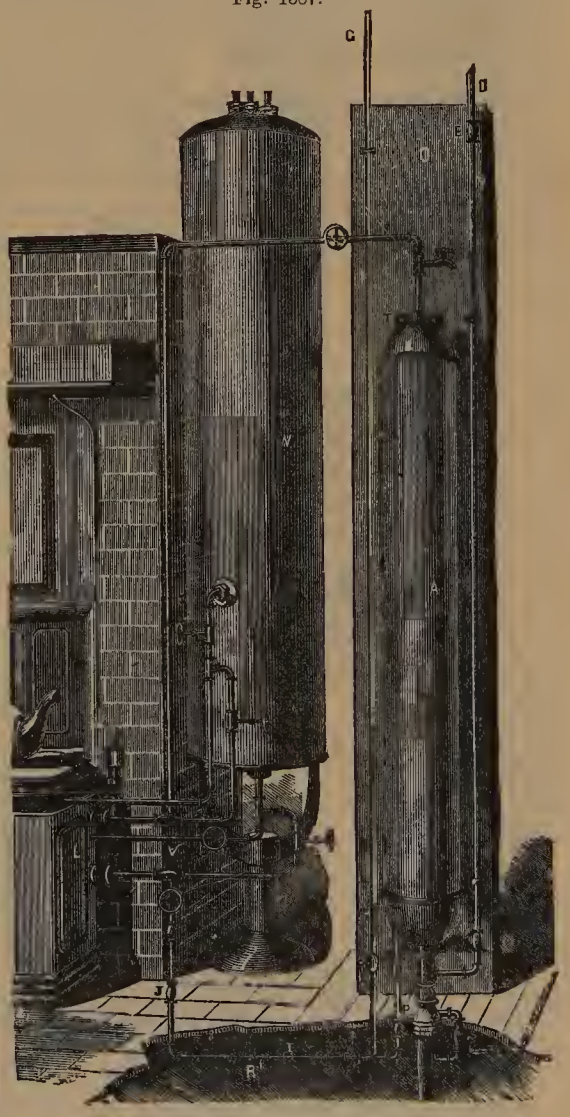
House Car. (*Railway.*) A box car, or closed freight car.

House Pump. One for the supply of a house when the pressure in the city mains is not sufficient for the high service in the house; or, when no urban water-works exist, to supply the house from ordinary wells or cisterns.

Houghton's automatic house pump is worked by the fire in the kitchen range. The cylinder *A* is a receptacle alternately for steam and water; its bottom is below the steam generator in the range, and its top not more than 25′ above the water supply, which is reached by a pipe extending from the bottom of the cylinder. The pipe has two valves, one near the near cylinder and one near the foot of the pipe. The steam generator is a back or cheek of the range furnace and has two nipples, for steam and water pipe connections respectively. The generator connects by pipe *F* with the top of the cylinder; the pipe has a cock to draw off steam or water when necessary, and a spring safety valve to obviate danger of explosion.

The pipe *G* conducts water from the tank above to supply

Fig. 1387.



Automatic House Pump.

the steam generator *L* through the branch *I*, and to condense steam in the cylinder through the branch *K*. In these branches are valves opening upward and towards the steam generator and cylinder, permitting water to flow into them, but closing downward by their own weight, and preventing the steam from driving the water up the pipe *G*, the pressure of the steam holding the valves in the pipes *I* and *K* to their seats against the weight of the column of water in the pipe *G*, which is pressing against the under side of them.

The cylinder and steam generator being filled with water, and a fire kindled, the water boils in the generator. The steam passes along the pipe *F* and expands in the top of the cylinder, and forces the water out of it up the outlet-pipe *D*, which rises above and emptics it into the tank at the top of the house. In this pipe is a valve which prevents the water from falling back in it, and air from entering the cylinder through it. This outlet, or rising pipe, is of such diameter that the steam will drive the water before it, leaving the lower end of the pipe empty of water and filled with steam. The top of the column pouring out into the tank, it becomes shorter and correspondingly lighter, and as the weight of this column of water determines the pressure of steam, the lighter the column the lower the pressure becomes. When the pressure of steam is too low to hold the valves in the pipes *I* and *K* to their seats, the water in the pipe *G* flows by them and refills the generator with cold water, and jetting into the cylinder, condenses the steam in it, producing a vacuum, which is instantly filled with water forced up from the well or cistern by the pressure of the atmosphere.

This operation will repeat itself as long as the fire is kept up, and requires no attention.

Hous'ing Box. (*Railway.*) The axle-box which moves up and down in the *housing* or *pedestal*.

Hov'er-er. A warm chamber for young chickens, used in connection with an incubator to give to the young chicks an artificial protection in place of the brooding hen. An *artificial mother*.

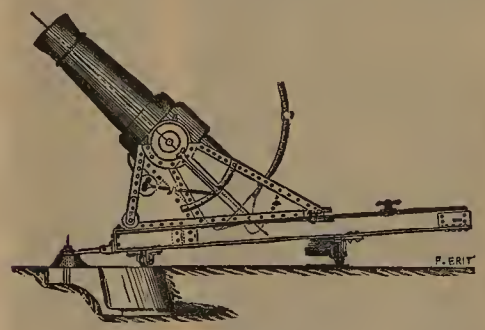
How'el-ing Ma-chine'. (*Coopering.*) See CHAMFERING MACHINE.

How'it-zer. A relatively short and large bored cannon for certain uses at short range.

Fig. 1387 shows a Spanish howitzer of 21 centimeters, système Barrios, with its carriage.

Mountain gun, sectional, *Armstrong*, Br. * "*Engineer*," xlvi. 365.
Mortar carriage, *King* . * "*Scientific American Sup.*," 514.

Fig. 1388.



Spanish Howitzer.

Moffatt's 6″ breech-loading flank defense, rifled howitzer, "*Ordnance Report*," 1877, Appendix R.

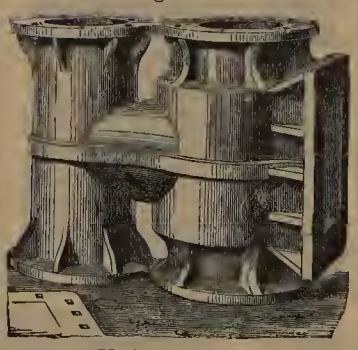
French rifled cast-iron howitzer, 22 cm., hooped, "*Ordnance Report*," 1878. Appendix L, Plate VII.

British 8″ rifled howitzer, *Ibid.*, Plate VII, Figs. 5, 6, 7; and p. 92.

Austrian rifled cast-iron howitzer of 21 cm. *Ibid.*, p. 96, and Plate VII. *b*, Figs. 10, 11. and figure not numbered, showing the piece mounted.

Rifled muzzle loading 6.3″ * "*Engineer*," xlv. 381.

Fig. 1389.



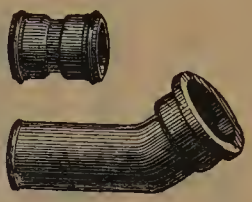
H-piece and Door.

H-piece. The section containing the valve-chamber of a Cornish engine.

By it is the door which closes the square opening by which access is had to the valve and chamber.

The door piece for a single pipe is shown at Fig. 841, p. 264, *supra*.

Fig. 1390.



Hub.

Hub. (*Add.*) 5. A short connecting pipe with a bell end for coupling pipes in line.

With two bell ends it is a *double hub*. With one of the ends smaller than the other, it is *reducer double hub*, and connects two pipes of varying diameter. See REDUCER.

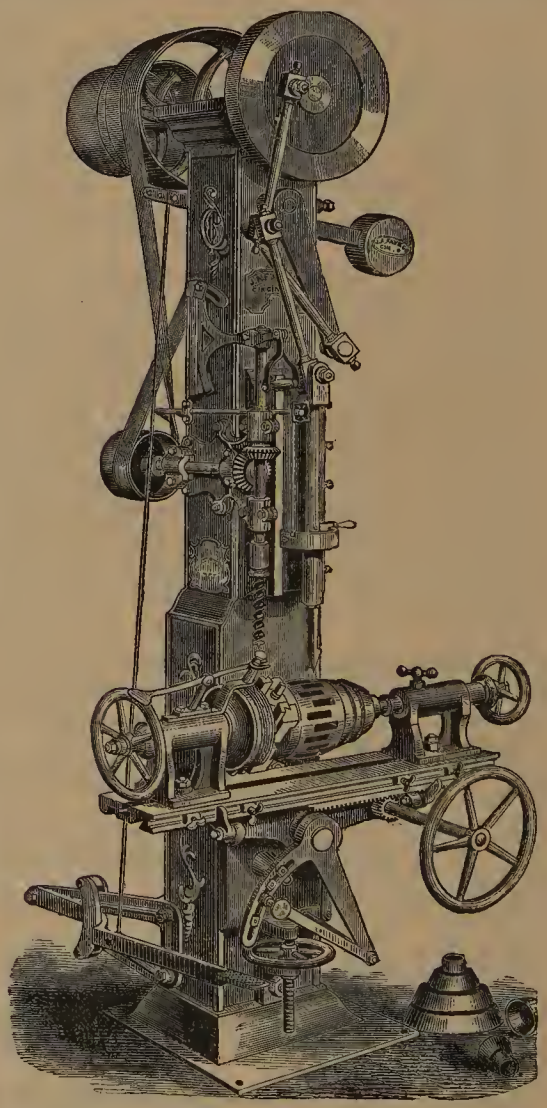
The lower figure in the illustration is a *bevel hub*.

Hub Bolt. (*Railway.*) The bolts by which the wheel plate is fastened to the hub, in the construction of paper-web car wheels.

Hub Mor'tis-er. A machine for making the spoke holes in hubs of vehicles.

The mortising and boring apparatus may both be driven by one belt from the counter shaft, or independent of each other, as may be desired.

Fig. 1391.



Hub Boring and Mortising Machine.

The hubs are confined in a screw chuck, the arms on its face being operated at the same time and by a single screw. It has a graduating wheel, spaced for 10, 12, 14, 16, and 18 spokes, thus obviating the necessity for setting out.

The dish of the mortise is regulated by a lever, having a crank and connections attached to the table. The lever has

a handle with a spring stop, which works into adjustable poppets in a slot on the same circle as the lever handle describes. The lever support with the slotted piece are rigidly fixed to the center, upon which the table swings, and convenient to adjust the angle of the mortise instantly.

It has a graduated stroke, commencing at a still point above the extreme upper throw, and working gradually down into the mortise with but slight jar; the chisel mandrel is vibrated only when the chisel is brought down to the work.

Defiance Machine Works, O. * "*Scientific Amer.*," xlii. 260.
Lane & Bodley . . . . . * "*Engineer*," xli. 450.
Perrin, Pauchard & Cie. . . * "*Engineer*," xlvii. 293.
Sundry . . . . . * "*Mech. Dict.*," p. 1140.

Fig. 1392.

Street Hydrant.

Hul'ler Gin. A cotton-gin which is adapted to gin cotton which is gathered with the bolls. See GIN, COTTON.

Hun-ga'ri-an Nail. A conical-headed nail, with round shank and flattened end pointed towards one side. Used in boot and shoe work. — *Field.*

Hunt'er's Knife. For attack or defense, or for flaying and evisceratiug animals.

Hur'dle. 1. (*Hydraulic Engineering.*) A structure to divert a current or prevent erosion. It consists of a row of stakes with wattled willows or brush. Into the spaces between the stakes and wattling, pieces of brush are pushed, standing as branches from 4′ to 8′ above the hurdle.

"*Report of Chief of Engineers U. S. Army*, 1879," * ii. 1028.

2. A hurdle fence is one made of removable sections attached to driven stakes.

Wickersham . * "*Scientific Am.*," xl. 163.

Hur'dy-gur'dy Wheel. (*Mining.*) A term used in California to denote a water-wheel driven by a jet from a flume pipe.

"*Mining and Scientific Press.*"
* xxxv. 361, 376.
"*Engineering and Mining Journal.*"
* xxiv. 188, 189.

Hurst. The frame on which a run of mill-stones is placed. A *husk.*

Hy'a-lithe. (*Glass.*) An opaque glass, usually black, and of remarkable strength. Used as a substitute for porcelain for vessels for boiling liquids, for coffee and tea-pots, etc.

To the usual white-glass compound add powder of calcined bones, iron scales, and charcoal.

It is made black, green, brown, red, by suitable additions to or restriction of elements in the compound.

See *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Verre*," vol. iii., ed. 1877.

Hy'dra. A self-registering thermometer with a compound head or bulb for holding the spirits; for increasing the surface exposed to the air and thereby causing the instrument to work very rapidly.

Hy'drant. A street connection to a water-main, to obtain water at the surface for extinguishing fires or watering streets.

Holly's fire-hydrant is shown in Fig. 1392. The axial vertical screw operates the main valve, which closes as it ascends. The main valve-seat is a leathern gasket, which serves also as a packing for the lower joint of the inner pipe. The hydrants are removable without disturbing the position of the shell in the soil. The extra frost jacket and drip-valve obviate freezing. The main valve closes with the current. The drip-valve is positive in its action, being held open by the main valve when the latter is closed, and closing as soon as the main valve is opened.

The gate at the base is for the purpose of cutting off the hydrant from the main when it is necessary to remove the former.

Fig. 1393 shows interior and exterior views of a street fire-hydrant. A key on top of the axial rod rotates the screw, which opens or closes the valve connecting with the main. The portion of the hydrant protruding above the surface has three connections for hose.

Fig. 1394 consists of two or more practically independent fire-hydrants secured to a common base, and permits the concentration of a number of independent fire-streams with a minimum amount of hose. A single casting acts as a washer, and also as a nut for all the operating screws. Either hydrant is readily detachable. — *Birkinbine.*

Fig. 1395 is another form in which the depression of the main valve uncovers the waste-pipe, and conversely.

Fig. 1393.

Fire Hydrant.

See: *Benson & Rose* . . * "*Scientific American*," xl. 390.
Birkinbine . . . . . * "*Iron Age*," xix., Feb. 8, p. 11.
"Perfection" . . . . * "*Iron Age*," xx., Nov. 22, p. 7.
Frost valve, Fig. 1102, p. 358, *supra.*

Hy'drant Cock. A faucet on a hydrant, having connections for hose and drip for waste-water when the spigot is closed.

Fig. 1396 shows several forms, straight and crooked.

Hy'drant Noz'zle. A screw-nose attachable to a hydrant, and having a screw at the outer end also, for the attachment of the coupling of the watering hose.

Hy'drant Suc'tion. A connection for a fire-engine, with a hydrant reservoir or cistern. Usually of rubber or canvas hose, with interior spiral coil to prevent collapse.

Stoddard's hydrant suction is a telescopic pipe, with screw couplings at the ends, and ball-and-socket joints to secure flexibility. See Fig. 1397.

Fig. 1394.

Cluster Hydrant.

Fig 1395.

Fire Hydrant.

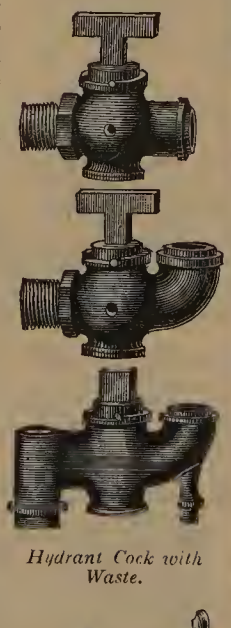
Hy'drant Valve. A valve connecting the hydrant with the main.

Fig. 1398 shows *Stone's* arrangement, which has a cast-iron body, gun-metal spindle, loose screw-down valve, and a flanged bottom for attaching to a vertical branch on the main.

Fig. 1399 is *Hawley's*, which has a gun-metal screw-valve and seating, and outlet bushed with gun-metal, screwed to fire-brigade gage.

Fig. 1400 is the Glasgow pattern, with clear straightway from the main, the valve actuated horizontally by rack and pinion.

Fig. 1396.



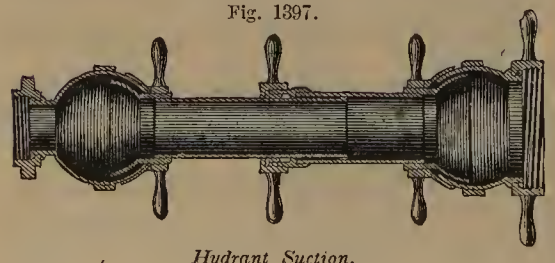
Hydrant Cock with Waste.

Hy-drau'lic Ac-cu'mu-la'tor. A device to form an accumulation of power, to be expended in assisting a machine over the pinch of a special exertion.

See ACCUMULATOR, p. 1, *supra.*

Tweddell, Br.
* "*Engineer*," xliv. 98.
* "*Engineering*," xxvi. 271.
* "*Manufac. & Builder*," xii. 105.
* "*Railroad Gazette*," viii. 563.
* "*Technologiste*," xli. 316.

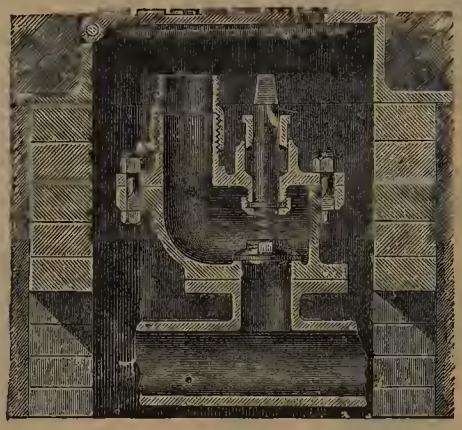
Fig. 1397.



Hydrant Suction.

Grimshaw . . . . . * "*Iron Age*," xxi., June 20, p 7.
Mordach . . . . . * "*Iron Age*," xvii., Jan. 13, p. 9.
Bell & Marshall . . . * "*Scientific American Sup.*," 3659.
* "*English Mechanic*," xxvii. 455
Kinney . . . . . * "*Scientific American*," xxviii. 127.

Fig. 1398.



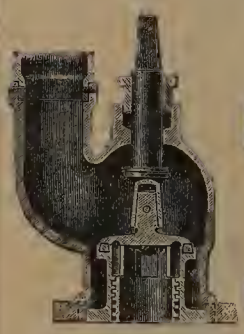
Hydrant Valve (British).

Hy-drau'lic Air'-pump. The application of the hydraulic engine to the pumping of air. A hydraulic blower.

An organ blower operated by hydraulic engine is shown in Fig. 3427, p. 1576, "*Mech. Dict.*"

The *trompe* used in the Catalan iron process is a hydraulic blower. See Fig. 6669, p. 2630, *Ibid.*

Fig. 1399.



Screw-down Hydrant Valve.

Fig. 1400.

Hydrant Valve (Glasgow).

See also HYDRAULIC BLOWER, *infra*, and devices in CARBURETOR, "*Mech. Dict.*" Very powerful engines are found in air compressors, especially for mining and tunneling See AIR COMPRESSOR, *supra*, and list on p. 12, *Ibid.*

Von Pauwel . . . . * "*Manuf. & Builder*," ix 142.

Hy-drau'lic Bal'ance. A governor or regulator placed between a water-wheel and a driving-shaft to maintain a steady motion under circumstances of changes of work by throwing machinery on or off. See HYDRAULIC REGULATOR.

Hy-drau'lic Bend'er. A hydraulic jack used in bending and straightening rails and bars See E, Plate XXV., opposite p. 1150, "*Mech. Dict.*"

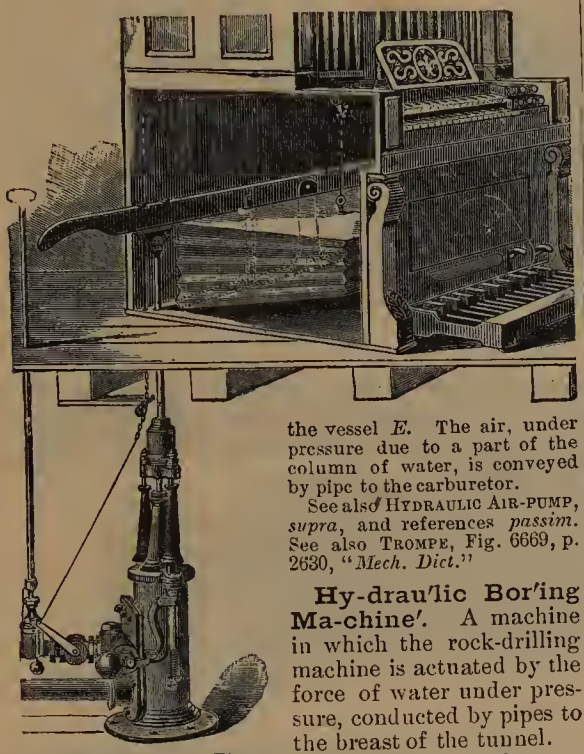
Hy-drau'lic Blow'er. An application of the hydraulic motor to the working of bellows.

Fig 1401 shows it as a reciprocating engine, worked by water from the main and oscillating the lever of the ordinary organ blowers. It is made self-regulating by attaching the upper valve of the organ by cords to the valve-lever, so as to proportion the induction of water to the condition of inflation of the bellows.

See also Figs. 3426, 3427, p. 1576, "*Mech. Dict.*"

Fig. 1402 is an application of the *trompe* to the purpose of forcing air to an apparatus for carbureting air The injection-pipe brings water from a spring or a city main, and is fitted with a nozzle, through which the water rushes, falling through the larger pipe *C*. In so doing, air is drawn in at the suction-pipe *D*, and both air and water fall together into

Fig. 1401.



Hydraulic Organ Blower.

the vessel *E*. The air, under pressure due to a part of the column of water, is conveyed by pipe to the carburetor.

See also HYDRAULIC AIR-PUMP, *supra*, and references *passim*. See also TROMPE, Fig. 6669, p. 2630, "*Mech. Dict.*"

Hy-drau'lic Bor'ing Ma-chine'. A machine in which the rock-drilling machine is actuated by the force of water under pressure, conducted by pipes to the breast of the tunnel.

The nature of the machine is in accordance with the action required, the percussion of the chisel, or the rotation of the diamond drill, — the latter, in the instance of the machine shown in Fig. 1403, made by Sulzer Brothers, of Winterthur, Switzerland.

The machine for drilling the rock in the tunnel of Mont Cenis is shown in Fig. 6777, p. 2654, "*Mech. Dict.*"; the air-compressor, by which the drills are driven, is shown in Plate X., opposite p. 602, *Ibid.* The use of compressed air is much more frequent than that of water for running the drills. See pp. 2654, 2655, *Ibid.* The same may be said of the use of steam; see ROCK-DRILL, pp. 1956-1958, "*Mech. Dict.*"

Hy-drau'lic Brake. See HYDRAULIC RAILWAY BRAKE.

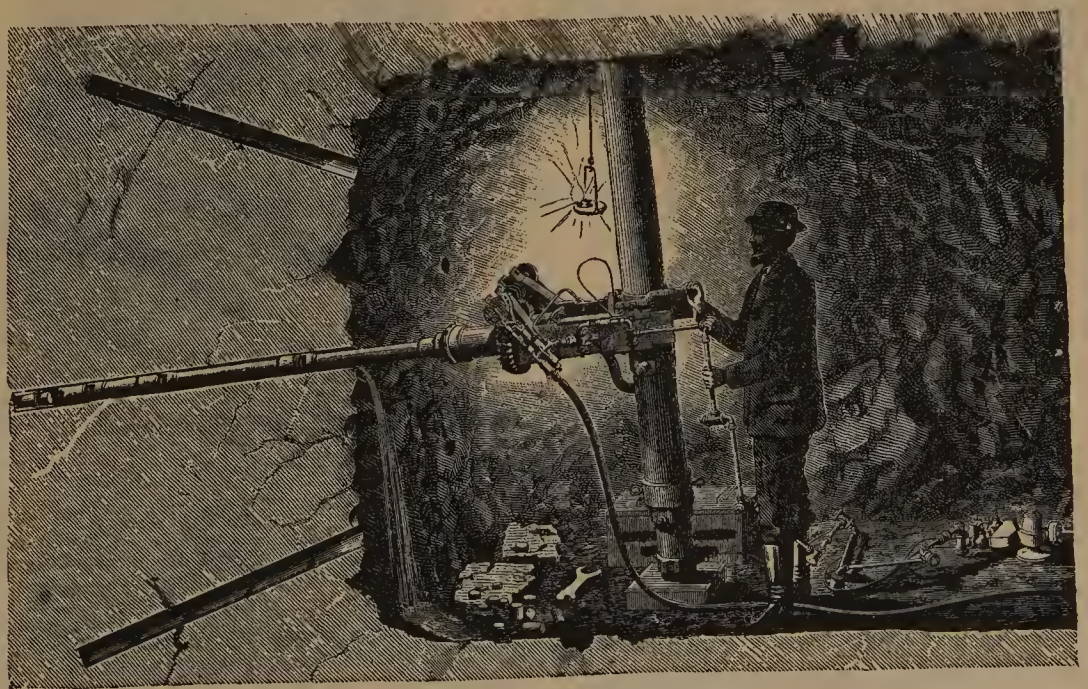
Hy-drau'lic Bridge Op'er-a'tor. An application of the hydraulic press to the moving of a pivot draw-bridge on its pintle, to open the waterway. See Fig. 1404, p. 476.

The motion is produced by the hydraulic pressure of the water on pistons in cylinders. The upper figure represents a ground plan of the center pier, the bridge itself having been removed so as to expose the rim with rollers on which it rests. There are four cylinders and pistons; the latter act on the revolving rim by means of heavy flexible wires, which pass through a packing in the cylinder-head. When the water is turned on so as to admit it to two diagonally opposite cylinders, its pressure will produce a pull on the wires, and these, being fixed to the revolving rim, will rotate it, and with it the whole draw, which rests on it. When the bridge has to be closed again, the water is turned on into the two opposite cylinders, while the same

Fig. 1402.

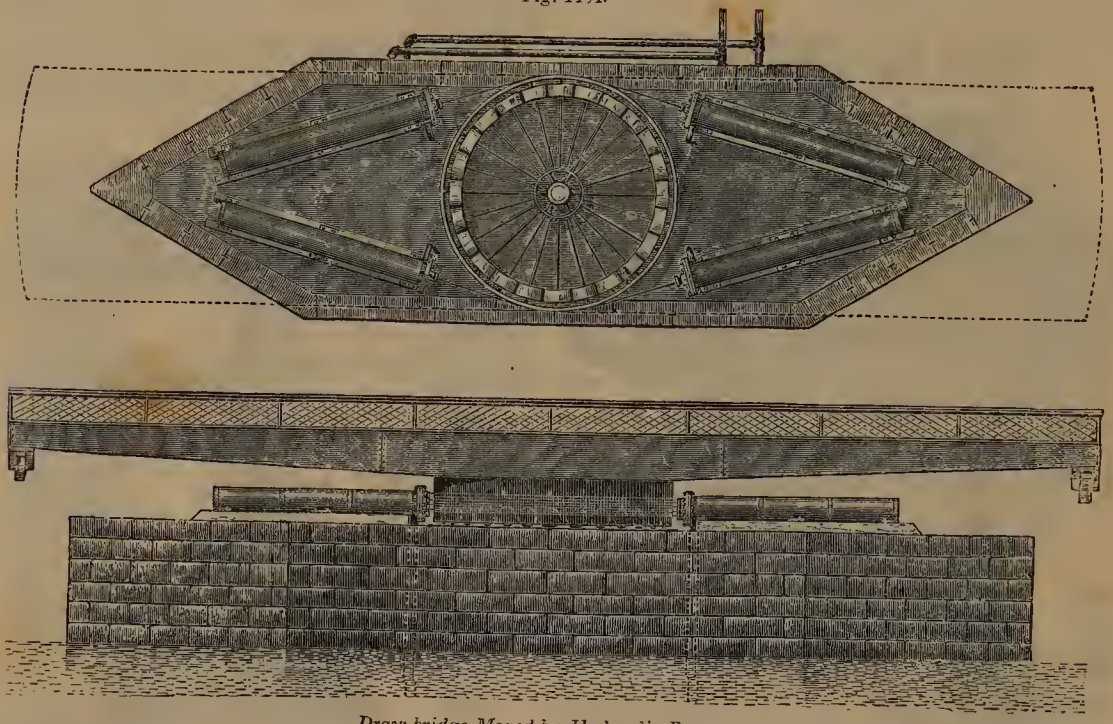
Hydraulic Blower.

Fig. 1403.



Sulzer's Hydraulic Boring Machine.

Fig. 1404.



Draw-bridge Moved by Hydraulic Pressure.

motion which turns on the water in two of the cylinders gives an exit to the water which has filled the two others. The water pipes are shown in the upper figure, one pipe for carrying the water to the pressure cylinders, which serve for opening, and the other pipe to those for closing the draw. The lower figure represents the bridge when open, resting entirely on the center pier, which is here seen longitudinally.

Hy-drau'lic Buf'fer. An arrangement of a piston in a cylinder to check the recoil of a cannon. The piston rod is made fast to the top carriage and moves in a cylinder filled with oil. The latter escapes through holes in the piston head, but with such difficulty as to impede the motion of the piston and thus act as a buffer.

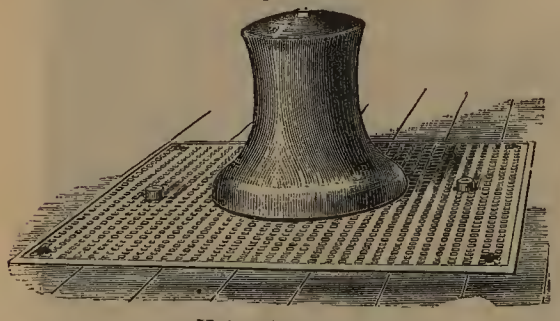
A quantity of air in the cylinder serves as a cushion to reduce the violence of the shock. The quantity of oil to be used, and the depth at the filling hole is marked on each cylinder. Otherwise known as a *recoil-check*.

See Fig. 83, Appendix L, to "*Ordnance Report*," 1877.
Plate VI., Appendix H, to "*Ordnance Report*," 1876.

Hy-drau'lic Cap'stan. One used ashore and operated by water under pressure.

Figs. 1405, 1406, show Brotherhood's three cylinder hydraulic capstan. It is a horizontal application of their familiar

Fig. 1405.

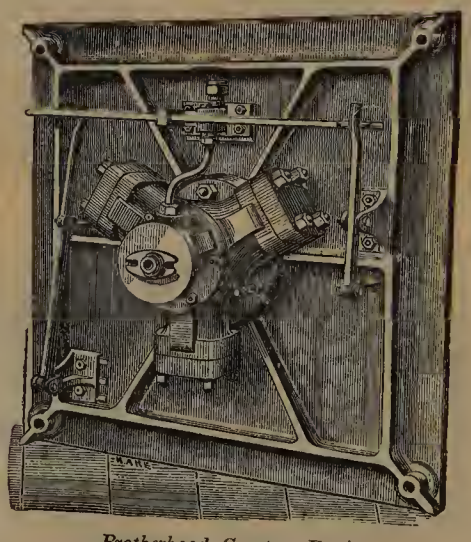


Hydraulic Capstan.

engine to the rotation of a capstan whose pintle is the common triple crank shaft of the trinary engine. Fig. 1402 shows the capstan on the plate beneath which the engine is fixed. Fig. 1406 is a view of the engine as it would appear if the plate were tipped up on edge and the bottom exposed.

The engine is very compact and is very simple. It is self contained and has but few working parts. There is but one valve in the engine, no glands, stuffing-boxes, or oscillating joints. The moving parts are subject to strain in one direction only. See also Fig. 531, p. 162, *supra*.

Fig. 1406.



Brotherhood Capstan Engine.

Hy-drau'lic Car Pro-pul'sion. A mode of propelling street cars by a hydraulic motor on each car, water being stored in each car under pressure of air at 20 to 30 atmospheres in a receiver.

The principle is the same, in most respects, as the plans proposed for air propulsion, stations at intervals refreshing the reservoir of the car. See notices under COMPRESSED-AIR ENGINE, p. 215, *supra*, and references *passim*. The water simply acts as the vehicle of transmission of the pressure of the air, and the benefit, if any, is in dealing with water rather than with air in the parts of the engine.

Hy-drau'lic Ce-ment'. Cement which will harden perfectly so as to exclude water. Cement which will harden under water.

Some limestones yield a perfect hydraulic cement, and in other cases materials are artificially united

in proper proportions. See HYDRAULIC CEMENT, p. 1144, "*Mech. Dict.*"

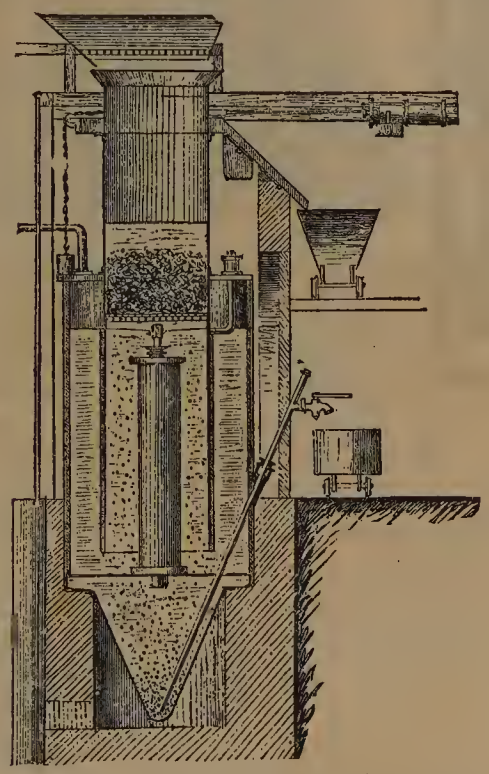
The English Portland cement, which has acquired a world-wide celebrity, is an artificial production, the special features of the manufacture of which are the following: Chalk and clay are ground together in water, the fine particles are floated away to other vessels and allowed to settle as a paste, which is thereupon collected, molded, dried, burnt, and finally ground. Certain porous, earthy, disintegrated rocks are found to be capable of cementing with lime in the natural state; that is to say, they do not require any preliminary preparation by burning as do the ordinary clays, it being simply necessary that they should be finely ground, in order that a thorough incorporation with the lime may be effected. These natural cements are generally of volcanic origin. The so-called pozzuolana and the trass are the best known of these deposits, both of which have been used from very ancient times. The pozzuolana, occurring on the coast of the bay of Naples — a species of tufa — was known on account of its cementing properties to the Romans, and by them largely employed. Vitruvius and Pliny both describe it, and state that it was mixed with an equal quantity of burnt lime for building under water. The same substance is very largely employed in the same manner at the present time. — "*Polytechnic Review.*"

See also TRASS.

Hy-drau'lic Clas'si-fi-ca'tor. (*Coal.*) A coal dressing apparatus by M. Evrard, of St. Etienne.

It consists of a vertical, hollow prism, either cylindrical or rectangular, 3 meters deep, the bottom of which is formed

Fig. 1407.



Evrard's Coal Dressing Machine.

by a movable piston-like inclosing rim, covered with a perforated plate, which can be raised to any height desired, as far up as the rim of the vessel, by means of a piston-rod attached to the under side and an upright hydraulic cylinder working upon it.

The vessel is prolonged beneath the piston in an open pipe of the same width and about 4 meters long, and both are submerged in a wider water-cistern, closed above and below and steam-tight, the cover being closely riveted to the outer covering of the vessel, and provided with a steam supply-pipe. By means of an intermittent supply of steam from the boiler, through the cover, into the upper part of the outer holder, the water therein receives an oscillating jerking motion, and works upon the minerals which are fed into the vessel and become heaped about 1.33 meters high upon the piston-sieve, just as with a jig-sieve. The only difference is, that the hydraulic strokes are much stronger at the start, being given with a lift as high as 20 centimeters, and then decrease to a few millimeters so that the action which follows at first just as with a slime separator, changes gradually to the action of a fine-jigging machine.

In this way a pause of one or two minutes is given, in order that the finest slime may properly settle on the piston-sieve, and then this piston is raised intermittently to the upper edge of the inner vessel, in order to scrape off the jigging-stuff over the edge in different layers, according as they lie upon the piston after sorting, and to obtain them separately as special products. The whole operation lasts about five minutes.

Hy-drau'lic Coal Mi'ner. An apparatus for breaking down coal *in situ*.

The breast of coal is undermined as usual and a hole drilled in it to hold an expanding plug of a cylindrical form worked by means of hydraulic pressure. The plug is composed of two halves, which have a little wedge-shaped space between them, and are jointed at the end to the extremity of a hydraulic cylinder, and receive between them a wedge-shaped extension of the hydraulic ram or plunger, fitting exactly the widest part of the wedge-shaped space, and extending about half its length when the ram is withdrawn into the hydraulic cylinder. When the pressure is applied to the ram, the wedge-like extension is driven further along the space between the two halves of the plug, which are forced apart, so that the plug is expanded in one direction beyond its original diameter, and by lifting breaks off the mass of coal.

See HYDRAULIC BORING MACHINE, *supra*.

Hy-drau'lic Com-pres'sor. A device in a gun carriage to check the recoil of the piece by receiving the impact upon a piston which condenses air in a chamber.

See PNEUMATIC SPRING, * p. 1755, "*Mech. Dict.*"
See also GUN CARRIAGE; HYDRAULIC BUFFER, *supra*.

Krupp . . . . . }
Rendel . . . . . } * "*Engineering*," xxviii. 37.
Vavasseur . . . . . }

Hy-drau'lic Crane. One in which the elevating chain is wound by hydraulic power.

The first crane worked by hydraulic power was put up on the quay of Newcastle-upon-Tyne by Sir William Armstrong, in 1846.

Fig. 1408 gives two views of a British crane of this kind. It is shown by side and end elevations, and is fixed against the wall of a warehouse in connection with a swing crane jib on the outside. The apparatus is used in connection with an accumulator, which is a vertical cylinder, proportioned in diameter and height to the number and power of the cranes or other machines to be employed. This cylinder is fitted with a leathern collar or gland, through which works a ram or plunger with a massive cross-head on the upper end, to which is attached an annular weight-case surrounding and sliding over the above-named cylinder. The weight-case is filled with ballast until the total weight on the ram is equal to (usually) 700 lbs. per square inch; water is then forced into the cylinder or accumulator by the hydraulic pumps, until the ram, loaded as above described, reaches the top of the accumulator. At this moment a self-acting arrangement arrests the motion of the engines, but immediately the ram begins to descend, in consequence of some of the stored power having been used, the engines and pumps are set in motion automatically, and the ram is again lifted.

The water passes from the accumulator to the cylinder of the ram, and, driving out the piston, draws upon the chain and lifts the load. The principle is shown also in Fig. K, Plate XXIV., p. 1157, "*Mech. Dict.*" The jibs are frequently of greater sweep than that shown, built up of plate and angle-iron, and fixed in a central position between two tiers of doors, one crane being thus made available for both sets of doors. The top pair of cylinders, shown in Fig. 1408, are used for slewing or turning the jib, and the bottom cylinder and ram for lifting the load.

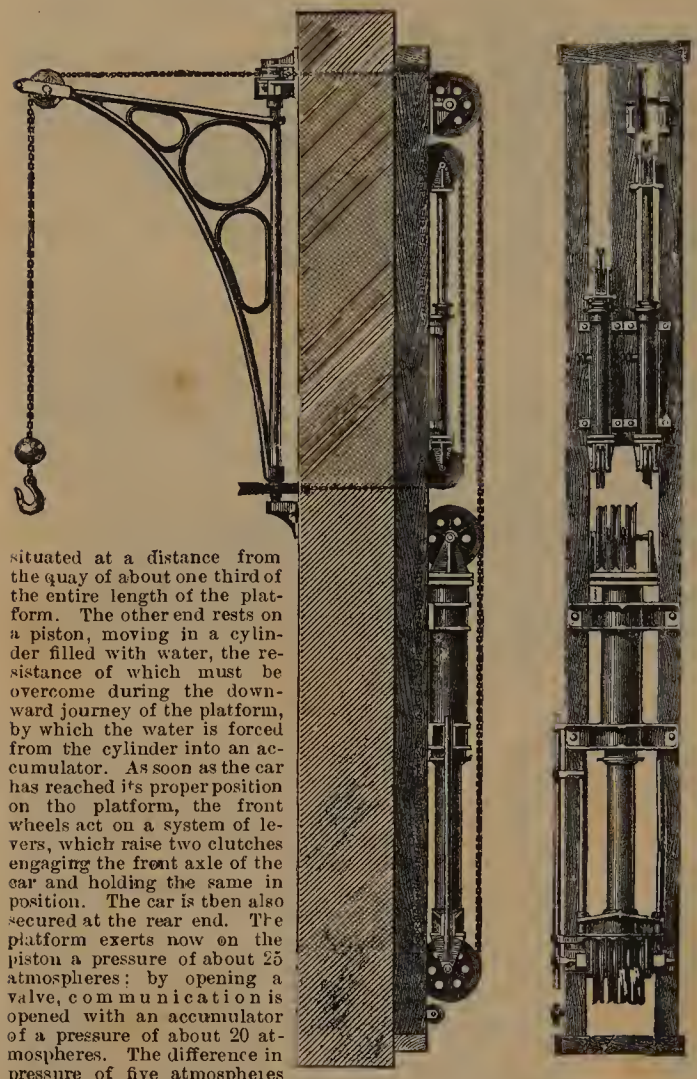
See: —

Armstrong, "*Engineer*" "*Scientific American Sup.*," 305.
160-ton . . . . . * "*Engineer*," xli. 168, 170.
Fielding & Platt, Br. . * "*Engineer*," xliv. 88.
* "*Scientific American Sup.*," 305.
Mills, Br. . . . . * "*Engineering*," xxiv. 134.
Tweddell, Br. . . . . * "*Engineer*," xliv. 98.

Hy-drau'lic Dump'ing. A tip for coal wagons to discharge them on to the chute.

As in similar constructions, the car or wagon is rolled on a platform, which, in most cases, rests with one end on the edge of the quay and swings around a horizontal axis,

Fig. 1408.



Hydraulic Crane.

situated at a distance from the quay of about one third of the entire length of the platform. The other end rests on a piston, moving in a cylinder filled with water, the resistance of which must be overcome during the downward journey of the platform, by which the water is forced from the cylinder into an accumulator. As soon as the car has reached its proper position on tho platform, the front wheels act on a system of levers, which raise two clutches engaging the front axle of the car and holding the same in position. The car is tben also secured at the rear end. The platform exerts now on the piston a pressure of about 25 atmospheres: by opening a valve, communication is opened with an accumulator of a pressure of about 20 atmospheres. The difference in pressure of five atmospheres forces the accumulator upward; this upward motion increases in rapidity as, by the change of position of the center of gravity of the car, the pressure in the cylinder is gradually increased to 40 atmospheres. As soon as the platform has attained an inclination of 45°, the accumulator has risen high enough to touch a lever, by which communication between itself and the cylinder is interrupted. Meanwhile the contents of the car have been dumped over the scoop-shaped end of the platform into the hold of the vessel below and the pressure in the cylinder has been reduced from 40 to 16 atmospheres. Connection with the accumulator having now been restored, the platform is brought into its original position by the overpressure of 20 — 16 = 4 atmospheres. Should the cargo of the car not weigh enough, a little water may be drawn from the accumulator by a separate stop-cock. Hereby the pressure is reduced and the platform lowered far enough to produce the necessary pressure by a change of position of the center of gravity of the car. Glycerine may be substituted for water when the apparatus is exposed to very low temperatures.

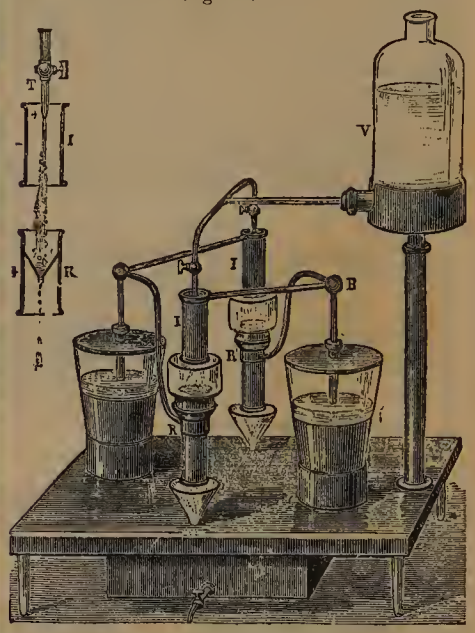
The principle involved in this apparatus is the storage of the weight of the cargo in an accumulator, and its employment for raising the empty car and platform after discharging the load.

See also references under DUMP CAR, p. 280, *supra*.

Hy-drau'lic E-lec'tric Ma-chine'. A machine in which electricity is excited by a flowing stream of water. — *Machine Électrique à Écoulement.*

The principle is illustrated in the small figure to the left in Fig. 1409, in which *T* is a metallic tube with a stop-cock, through which a small stream of water runs in drops from a reservoir, while it is electrically connected with the earth. It is surrounded by an isolated metallic cylinder, *I*, which induces a positive electrical conduction in the tube *T* and in the stream of water, by being itself once for all charged with negative electricity by contact with a piece of rubbed gutta-percha, hard rubber, sealing-wax, or equivalent substance. The cylinder *I* is called the *inductor*. These charges are indicated by the — and + signs. The falling drops of water being positive electric, communicate their charge to a funnel placed in the metallic cylinder *R*, which therefore, also, becomes positive electric, and is called the *receiver*. As electric charges always go to the outer surface of cylinders, the water flowing out of the funnel will be neutral, and all the positive electricity left behind in the outer cylinder *R*. Its charge increases continually,

Fig. 1409.



Hydraulic Electric Machine.

until the charge of the drops of liquid falling from *T* is in equilibrium with the loss, or until electric sparks fly over between the lower cylinder *R* and the upper one *I*, or until the drops from the tube *T* no longer fall down in the funnel *R*, being repelled sideways and thrown outward by the equally positively charged cylinder *R*.

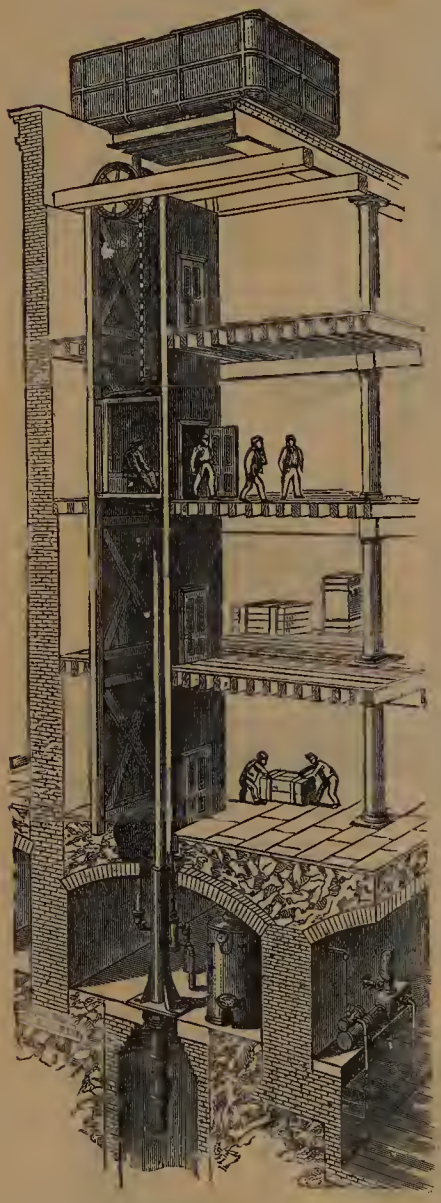
If nothing more were added to this arrangement, it would be necessary to renew the negative charge of the cylinder *I* frequently; but Fig. 1409 represents a double apparatus on this principle, invented by *Thompson*, and so arranged by duplication of parts, one set next to the other, that the electricity of the lower cylinder *R* of one charges the upper cylinder *I* of its other, of which then the electric charges will be reversed, the upper cylinder *I* will be positive, and the lower one *R* negative.

The reservoir *R* of the nearest set of cylinders is connected with the inductor *I'* of the farther set, while the receiver *R'* of this set is connected with the inductor *I* of the nearest set. The drops falling from the second inductor *I'* are then negatively charged, and give this charge to the second receiver *R'*, which increases the charge of the first inductor *I*. Added to the connections, of which, of course, one is always positive and the other negative, are two Leyden jars, *A* and *B*. The jars are truncated cones, of flint glass of good isolating quality, coated exteriorly with tinfoil, and interiorly containing a quantity of strong sulphuric acid, into which dip the lead rods, which at their lower ends have lead plates; the rods are surrounded by a glass tube and pass through the center of a cover of hard rubber. This is done to secure for the interior of these jars a perfectly uniform dry atmosphere.

The dynamic value of the electricity thus produced is derived from the power of the falling liquid: it would be equal to the work performed by gravitation on the drops of liquid during their downward route, if the drops arrived in the funnels after having lost all their velocity, and it corresponds exactly to their loss in *vis viva*. The loss of electricity is so weak in this apparatus, that the charge can be kept up for years by means of an insignificant discharge of liquid; a single drop, for instance, falling from each stop-cock every three minutes, has been found sufficient to keep up a constant charge.

The matter is considered more at length in "*Manufacturer and Builder*," * ix. 252.

Fig. 1410.



Hydraulic Elevator.

Hy-drau'lic El'e-va'-tor. A lift operated by hydraulic pressure.

Several methods of application of hydraulic force to this purpose are given in Plates XXIV., XXV., pp. 1150–1157, "*Mech. Dict.*"; and WATER ENGINE, Figs. 7101, 7102, p. 2738, *Ibid.* See also references at ELEVATOR, p. 309, *Ibid.*, and ROPE ELEVATOR, Fig. 4437, p. 1979, *Ibid.*

The Ascenseur Édoux is shown in Fig. 1410. It is regarded as the safest of all methods, and is remarkably smooth and noiseless in action.

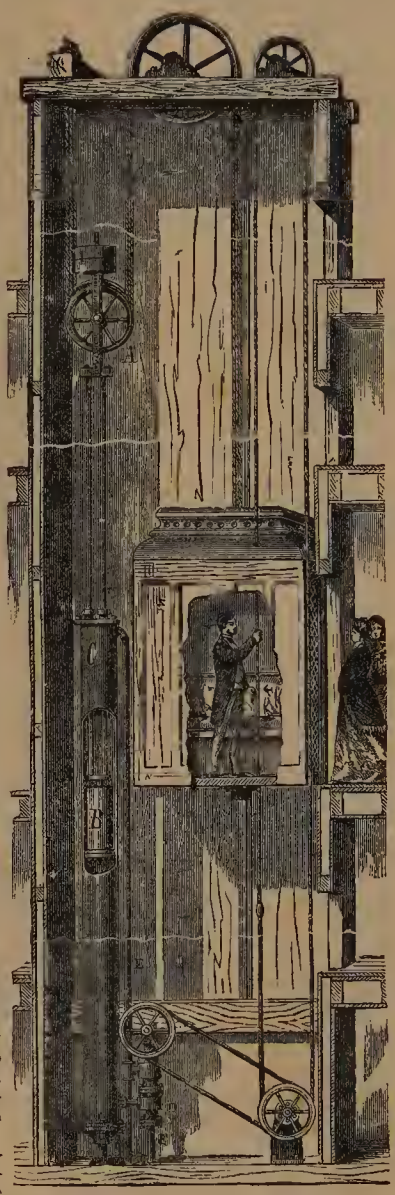
It consists of a hydraulic cylinder equal in length to the height of the desired lift (sometimes 70′ and upward), placed vertically in a well or bore-hole, and a ram of area proportionate to the work to be done and the pressure of water available. The cylinder is fitted with a gland or leathern collar, and on the head of the ram rests the cage or ascending room, which is guided by suitable guide timbers. The motion is regulated by an equilibrium valve, admitting the water into the cylinder or letting it run to waste. The valve can be controlled from a rod which passes down one corner of the lift, and only requires a gentle pull to stop at any desired floor or to start again.

These lifts are always fitted with compensating counterbalances, exactly equal to the weight of the cage and the ram, insuring the utmost economy of water in working. The water pressure is obtained in various ways, from an accumulator, from the city main, or from an elevated cistern, as in the illustration, Fig. 1409, in which is a steam pump to keep the cistern supplied.

Fig. 1411 is *Hale's* hydraulic elevator, in which the ram *B* in the cylinder *C* is made to draw upon a pulley, *A*, and so wind up the suspending rope of the cage. *D* is the pump, *F* water supply, and *E* pipe leading to ram cylinder *C*.

While it is impossible to eliminate all chances of danger in lifting machinery, and preference has been expressed for the ascenseur Édoux on account of its avoidance of the use of a lifting cable, it must be acknowledged that it has one weak spot, and that is the parting of the connection between the cage and the lifting tube, in which case the counterbalance carries the cage violently upward and breaks the connection at the top, allowing the cage to drop. This was the cause of the fatal accident at the Grand Hotel in Paris, in 1878.

Fig. 1411.



Hydraulic Elevator.

See: —

Water elevators . . * "*Mech. Dict.*," Figs. 7101, etc., p. 2738.
* "*Scientific American Sup.*," 105.
Burden . . . . * "*Manufact. & Builder*," x. 265.
Water lifter, *Cranston* * "*Min. & Sc. Press*," xxxvi. 305.
Elevator, *Cushing* . * "*Man. & Builder*," xii. 198, 232.
Otis . . . . . * "*Manufact. & Builder*," xi. 221.
Lift, river Weaver, Br. * "*Engineer*," l. 157, 160.
Lift, Trocadéro, Paris * "*Engineer*," xlvi. 377.
Tweddell . . . . * "*Engineer*," xliv. 98.

See several previous articles under HYDRAULIC CRANE, Fig. 1408, p. 478: GRID, Fig 1230, p. 423.

Illustrated article in *Laboulaye's* "*Dictionnaire des Arts et Manufactures*," article "*Treuil Hydraulique*," iii., ed. 1877.

Hy-drau'lic En'gine. An engine operated by pressure of water.

Two forms of hydraulic engines are made by *Pratt & Whitney*. One with a rotary movement; it is a simple reciprocating engine worked under a water pressure of 20 pounds to the square inch or upward. It is intended for furnishing limited power for working printing presses, for small shops, etc., and the stroke is adjustable from 4″ to 10″.

The hydraulic engine for blowing pipe-organs works noiselessly and without thump, as the stroke of the piston connects directly with a partially rotary movement. It works under all pressure with equal facility.

See HYDRAULIC BLOWER, *supra*, and Figs. 3426, 3427, p. 1576 "*Mech. Dict.*"

The *Stannard* hydraulic engine resembles a small horizontal steam-engine, and is intended to be used, in any locality where a head of water can be obtained, to act as a light motor. The length of the stroke is adjustable at will, from 4″ to 8″, according to the quantity of water available, or power required. Diameter of cylinder, 5″.

White's dental engine is shown in Fig. 795, p. 250, *supra*.

The Valley Machine Co.'s engine is a small compact upright form for a domestic motor, or use in small shops.

See Figs. 2614, 2615, pp. 1145, 1146, "*Mech. Dict.*"

See also WATER-PRESSURE ENGINE, Figs. 7120–7124, pp. 2743, 2744, *Ibid.*

See: Motor, *Knecht* . . * "*Scientific American*," xli. 278.
Engine, *Richardson* . . * "*Scientific Amer.*," xxxvi. 262.
Hubbard & Allen . . . * "*American Artizan*," xix. 6.
Hydrant, *Root* . . . * "*Iron Age*," xx., Oct. 25, p. 1.
Rotary, *Root* . . . . * "*Min. & Sc. Press*," xxxvi. 353
* "*Sc. American*," xxxviii. 150.
Motor, *Schmid*, Switz. . "*Engineer*," xlvi. 210. Fig. 3.
Schmid, at Paris Exp. * "*Scientific Amer.*," xxxix 327

Hy-drau'lic En'gi-neer'ing. See under the following heads: —

Air camel.	Graving dock.
Air lock.	Grouser.
Apron.	Hopper barge.
Aqueduct.	Hurdle.
Barrage.	Hydraulic grading.
Boom.	Jetty.
Boring anchor.	Lighthouse.
Breakwater.	Lock gate.
Brush dike.	Mat.
Canal.	Mat boat.
Canal lift.	Mattress.
Canal lock.	Mattress boat.
Coffer dam.	Movable dam.
Crib breakwater.	Navvy
Crib dam.	Overflow basin.
Curtain.	Pier.
Dam.	Pile dam.
Dike.	Pile driver.
Dipper.	Pneumatic excavator.
Draining.	Pneumatic pile.
Dredge.	Revetment.
Dredge boat.	Revetment mattress.
Dredging machine.	Rip-rap.
Drilling scow.	Sabot.
Drum barrage.	Sand fence.
Drum weir.	Screw pile.
Dry dock.	Sheer boom.
Embankment.	Shutter dam.
Fascine.	Shuttle.
Flask.	Slide.
Floating brush dike.	Sounding.
Floating derrick.	Sub-aqueous excavator.
Floating dock.	Submarine excavator.
Floating wire dike.	Submarine grapple.
Flume.	Submarine tunnel.
Gabion.	Towing.
Gabionade	Tubular foundation.
Grapnel.	Tubular pile.
Grapple.	Weir.
Grapple dredging machine.	Willow curtain.

Consult: *Stuart's*, "*Naval Dry Docks.*"
Foster's, "*Submarine Blasting.*"

Hy-drau'lic Force Pump. The pump used in connection with a hydraulic press. Such are shown in Plates XXV., XXVI., "*Mech. Dict.*," opp. pp. 1150, 1156. See also BOILER PROVER, Fig. 763, p. 320, *Ibid.*; HYDRAULIC PRESSURE PUMP, *infra.*

Hy-drau'lic Forge. A press operated by hydraulic power, as a substitute for the hammer.

Reference has been made under STEEL PRESS, * p. 2369, "*Mech. Dict.*," to the method adopted by Révolier & Co., and others.

The Woolwich Arsenal gun carriage department has a hydraulic press for forging iron. The machine is capable of exerting a force of 3,000 tons, and it will probably supersede the steam hammers to some extent.

The Haswell system is described by *Prof. Blake* in his report, * "*Vienna Exposition* (1873) *Reports*," iv., pp. 257–262.
Prof. Thurston's report, *Ibid.*, iii. 335.
See also "*Engineering & Mining Journal*," xxiii.
"*Manufacturer & Builder*," ix. 179.

Hy-drau'lic Gage. The manometer applied to register the pressure in a hydraulic engine, press, or pump.

Hy-drau'lic Gra'ding. Views and details of experiments in grading steep river banks by means of hydraulic nozzle, preparatory to placing woven mattress work upon them as a revetment, are shown in "*Rep. U. S. Engineers*," 1880, * ii., pp. 1444–1449.

Hy-drau'lic Grid. The gridiron or platform on which a vessel is lifted by hydraulic pressure, or by camel. See GRID, p. 423, and DEPOSITING DOCK, Plate IX., *supra.*

Hy-drau'lic Gun'-car-riage. A piece provided with hydraulic apparatus for elevating into battery, depressing, and working.

See also HYDRAULIC COMPRESSOR.

Raskazoff, Russia . . . * "*Engineering*," xxiii. 305.

Hy-drau'lic Hoist. An arrangement for lifting vessels clear of the water, on inclines or vertically.

See *J*, Plate XXV., opp. p. 1150, "*Mech. Dict.*"
Also GRID, Fig. 1280, p. 423, *supra.*

Marine slips . . . . * "*Scientific Amer.*," xxxvii. 130.
Docks, Engl, ... * "*Scientific American Sup.*," 1696.
Marillier, Hull, Br. . . * "*Engineer*," xliv. 350.

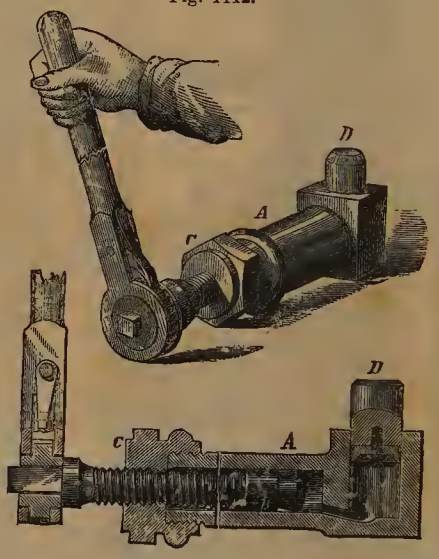
See also HYDRAULIC CRANE; HYDRAULIC ELEVATOR: HYDRAULIC JACK.

Hy-drau'lic Jack. An application of the hydrostatic press to a portable lifting or pushing instrument.

Several forms are shown at M, M′, M″, M‴, O, Plate XXV. p. 1157, "*Mech. Dict.*"

Fig. 1412 shows a jack for forcing crossheads out of piston rods, bolts from engine frames and cylinders, crank pins out

Fig. 1412.



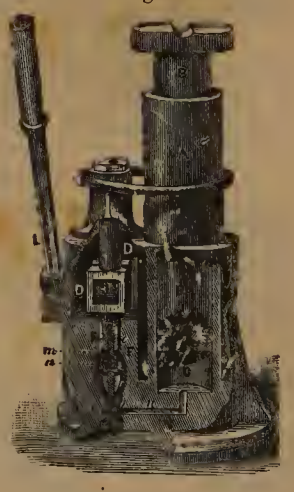
Hydraulic Jack.

of locomotive driving-wheels, and for performing similar work in which it is necessary to employ a tool of large power in a small space. It consists of a long tube, *A*, in which works a piston, *B*. The latter is provided with suitable packing, and its rod is a screw working in the cover *C*. *D* is the ram of the jack. The handle has click and rachet so as to work by a vibratory movement.

Fig. 1413.

Hydraulic Jack.

Fig. 1414.



Hydraulic Jack.

Fig. 1413 is Justice's hydraulic jack. It is filled with a liquid.

Water	1
Whiskey	6
Oil	0.5

Well shaken together before being filled into the jack. The pump-piston works in guides at top and bottom; the jack will work with any wrench or

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